

PROCEEDINGS  
OF THE  
SCIENTIFIC MEETINGS  
OF THE  
ZOOLOGICAL SOCIETY OF LONDON.

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January 19, 1886.

Prof. W. H. Flower, LL.D., F.R.S., President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of December 1885:—

The total number of registered additions to the Society's Menagerie during the month of December was 157. Of these 2 were by birth, 137 by presentation, 2 by purchase, 2 by exchange, and 14 on deposit. The total number of departures during the same period, by death and removals, was 116.

The most noticeable additions during the month were:—

1. A male Cheetah (*Cynælurus jubatus*), received December 8th, presented to the Society by Nawab Mirza Hassim Ali Khan, of the Afghan Frontier Survey. A pair of feline animals captured, in November 1884, near the Istoi Pass on the Perso-Afghan frontier, when quite young, after the mother had been shot, by some of the members of the Afghan Boundary Commission, were believed at the time to be Snow-Leopards (*Felis uncia*)<sup>1</sup>, and were forwarded to Pisheen, where they were kindly kept through last summer by Mr. H. J. Barnes, Political Agent at Quetta. The survivor of them, having arrived in this country, proves to be not a Snow-Leopard, but a fine young male Cheetah (*Cynælurus jubatus*).

The Cheetah was well known to occur in Persia (see Blanford's 'Eastern Persia,' vol. ii. p. 35), but I am not aware that its occurrence so near the frontiers of Afghanistan has been actually recorded.

2. A young female Tiger, deposited by J. E. T. Aitchison, Esq.,

<sup>1</sup> See Sir Peter Lumsden's letter, P. Z. S. 1885, p. 610.



M.D., Naturalist to the Afghan Boundary Commission. This specimen seems to belong to the small and densely furred form of *Felis tigris* prevalent in northern latitudes. This animal is stated to have been captured on the Hari-rud, between Sarakhs and Pulikátúm.

3. Four young Gazelles obtained during the survey of the boundary of Northern Afghanistan, and deposited by the same gentleman. These Gazelles are probably referable to *Gazella subgutturosa*, but seem to differ somewhat from our previously received specimens of the same species.

4. Two curious hybrid Ducks bred in 1884, at Cannes, between the Ruddy Sheldrake (*Tadorna rutila*) and the Egyptian Goose (*Chenalopex ægyptiaca*). This pair of hybrids was presented to Dr. T. E. Charles, of Cannes, by Madame de la Blanchetais, of the same place. Dr. Charles presented them to Sir Joseph Fayrer, who has kindly transferred them to the Society's Collection.

The Secretary laid upon the table a series of specimens of Lepidopterous insects which had been bred in the Insect-House during the past season, and read the following report upon the subject drawn up by Mr. A. Thomson:—

The following species of insects have been exhibited in the Insect-House during the past season:—

*Silk-producing Bombyces.*

Indian.

<i>Attacus atlas.</i>	<i>Attacus pernyi.</i>
— <i>cynthia.</i>	<i>Actias sclene.</i>
— <i>ricini.</i>	<i>Antheræa mylitta.</i>

American.

<i>Samia cecropia.</i>	<i>Actias luna.</i>
* — <i>ceanothi.</i>	<i>Hypochoera io.</i>
<i>Telea polyphemus.</i>	

African.

* <i>Gyanisa maia.</i>	* <i>Bunea caffraria.</i>
* <i>Antheræa cytherea.</i>	* <i>Cirina forda.</i>
* — <i>tyrreha.</i>	

*Diurnal Lepidoptera.*

<i>Papilio podalirius.</i>	<i>Euchloe cardamines.</i>
— <i>alexanor.</i>	<i>Lycena corydon.</i>
— <i>machaon.</i>	* <i>Limenitis disippus.</i>
* — <i>asterias.</i>	<i>Vanessa antiopa.</i>
<i>Thais polyxena.</i>	— <i>atalanta.</i>
<i>Parnassius apollo.</i>	— <i>levana.</i>
<i>Aporia hippia.</i>	— —, var. <i>prorsa.</i>
— <i>cratægi.</i>	<i>Melitæa cinxia.</i>

\* Exhibited for the first time.

## Nocturni.

<i>Smerinthus ocellatus.</i>	<i>Bombyx quercus.</i>
— <i>populi.</i>	* <i>Hemileuca maia.</i>
— <i>tiliæ.</i>	<i>Lasiocampa quercifolia.</i>
<i>Sphinx ligustri.</i>	* <i>Diptera ludifica.</i>
<i>Deilephila euphorbiæ.</i>	<i>Endromis versicolor.</i>
* <i>Hemaris marginalis.</i>	<i>Saturnia carpini.</i>
<i>Euchelia jacobææ.</i>	<i>Dicranura vinula.</i>
<i>Callimorpha hera.</i>	* <i>Clostera anachoreta.</i>
<i>Arctia caxa.</i>	<i>Notodonta ziczac.</i>
<i>Chelonia villica.</i>	<i>Catocala fraxini.</i>
<i>Liparis chrysoŕrhea.</i>	

It will be noticed from the preceding list, that the three species of European *Papilio*, viz. :—*P. podalirius*, *P. alexanor*, and *P. machaon*, have been exhibited, and that specimens of *Papilio asterias*, from N. America, were exhibited for the first time. Together with the pupæ of this last-named species, I obtained some very small larvæ (hibernating) of *Limenitis disippus*. They had spun up in small leaves, but after being in the warm Insect-House for a few days, they came out and commenced to feed very freely upon weeping willow ; they grew rapidly and ultimately produced some very fine imagos, some of which I have the honour to exhibit this evening.

I again obtained by exchange some larvæ of *Aporia hippia*, and I took the opportunity to get a coloured drawing made of the larvæ, pupa, and imago of this little-known insect, which I now exhibit<sup>1</sup>.

Of the American silk-producing Bombyces, *Samia ceanothi* was exhibited for the first time, and I succeeded in obtaining fertile ova from one pairing, and in due course the larvæ ; but I regret to say that they all died. Of the 2nd, 3rd, 4th, and 5th stages, I exhibit coloured drawings which Mr. F. W. Frohawk was good enough to make from the living larvæ. The larvæ in the first stage were black, similar to those of *Samia cecropia*.

Although the pure-bred larvæ died, some hybrids which I obtained from a pairing of a male *Samia cecropia* with a female *S. ceanothi*, throve remarkably well, and there are over 60 cocoons now in the Insect-House, from which the insects may be expected to emerge early in the coming spring.

Early in the past season, I purchased about four dozen large pupæ from South Africa, which had been stripped of whatever cocoon or other covering they had possessed, so that it was not possible to determine to what species they belonged ; it could only be seen that they were Bombyces of some kind. As will be seen by the list, examples of five species were obtained from them. They were very irregular in their appearance, the first emerging on May 7th, and the last on September 29th. I obtained a pairing of *Gyanisa maia*, but the larvæ, I am sorry to say, died, although one fed, till it reached its third stage, on Laburnum. Good specimens of *Antheræa tyrrhea*, Fabr., are, I believe, rather scarce in collections.

<sup>1</sup> See Mr. Butler's paper, *infra*, p. 80.

Young larvæ were obtained of the following species:—*Attacus atlas*, *A. mylitta*, *A. pernyi*, and some hybrids said to be hybrids between *Attacus pernyi* and *A. mylitta*, and between *A. pernyi* and *A. roylei*, *Actias selene*, *Samia ceanothi*, and hybrid *Samia cecropia* and *S. ceanothi*. Of these, *Attacus pernyi* and the hybrids only were reared, the other specimens all died. Every attention was given to them, and I regret to have to express my opinion that the present Insect-House is not a suitable building for rearing young larvæ. At the same time, it must be borne in mind that the past season was, in consequence of the long drought, bad for rearing larvæ, as the leaves of the food-plants became hard and dry early in the summer. Apart from this, the leaves of all trees growing in or near the Gardens get very dirty with smoke, and although the precaution is always taken to wash the food before using it, the leaves are not so fresh and good for feeding as those obtained from the open country.

The larvæ of *Attacus pernyi* were reared upon the English Oak when the leaves were young and succulent, and they grew very rapidly and did well.

The so-called hybrids of *Attacus pernyi* and *Attacus roylei* were reared, and a good number of cocoons obtained. The hybrids (?) of *Attacus pernyi* and *Attacus mylitta* did not do so well, and only three cocoons were obtained. One insect from each of these cocoons has emerged up to the present, and these are, in my opinion, *Attacus pernyi* pure. I tried to obtain pairings of *A. pernyi* with females of *A. mylitta*, but did not succeed, although the insects were in the finest condition, and the males of *A. pernyi* were most energetic in their endeavours to pair with the females of *A. mylitta*. I had no opportunity of trying this experiment with *Attacus roylei*, as I had not any of that species.

I am sorry to have to record the death, in November, of the very fine *Mygale fasciata*, which was presented to the Society by Mr. H. R. P. Carter, in January 1885, and of which a life-sized figure was published in the 'Field' of April 25, 1885, together with some notes by Mr. W. B. Tegetmeier, F.Z.S.

The colours of this Spider during life were very beautiful.

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A communication was read from the Rev. T. R. R. Stebbing, containing descriptions of some new Amphipodous Crustaceans from Singapore and New Zealand. The species were shortly described as follows:—

1. *BYBLIS KALLARTHUS*, sp. nov.

This new Amphipod was brought from Singapore by Brigade-Surgeon S. Archer.

The most striking peculiarities are the doubly sinuate lower margins of the fourth pair of side-plates, the branchiæ carrying on their surfaces rows of overlapping secondary vesicles, and the third uropods, in which the inner margin of the outer branch and the outer margin of the inner branch are much ornamented. The head

in this species is long, very much narrowed distally; the telson is divided beyond the centre.

The following accounts of *Talorchestia tumida* and *Amphithopsis cærulea*, from New Zealand, were sent along with the specimens by Mr. G. M. Thomson, their discoverer. His remark that in *Amphithopsis* (*Pherusa*?) *cærulea* the 4th coxa is broader than the preceding three together, applies to the appearance in the undissected specimen, not to the coxæ or side-plates when drawn apart.

“2. TALORCHESTIA TUMIDA, n. sp.

General form of body, when seen from above, much inflated. Eyes large (in living specimen of a turquoise-blue colour).

*Anterior antennæ* very short, reaching a little past the extremity of the penultimate joint of the peduncle of the posterior pair; flagellum 7-8-jointed, subequal with peduncle. *Posterior antennæ* as long as cephalon and first two segments of pereion, last joint of peduncle much the longest; flagellum 12-14-jointed, slightly shorter than peduncle.

Males apparently of two forms:—

*First Form.*—First gnathopod with the propodos somewhat curved, its inferior margin distally produced and rounded; dactylos curved and much longer than the palm; carpus and propodos with numerous spines. Second gnathopod with the carpus small and triangular; propodos ovoid and smooth, palm very oblique and furnished with two rows of minute teeth; dactylos two thirds as long as propodos, with its point lying over the edge of the palm. Third pereopod short, fourth and fifth very long, former with the bases not dilated.

*Second Form.*—Second gnathopod with the propodos broadening towards the distal margin, palm nearly transverse with a blunt tooth between the middle and hinge of the dactylos; latter furnished with a large tooth impinging outside of the tooth of the palm. Third and fifth pereopoda normal: fourth with the the carpus nearly quadrate and broadly dilated.

Telson nearly as broad as long, quite round at the apex and fringed above with a submarginal row of minute spines. Colour, when alive, ivory-white.

*Hab.* In sandbanks, Purakanui near Dunedin, among roots of littoral plants, many yards from high-water mark. Each specimen inhabiting a hole of its own. When taken out they leap with great vigour.

“3. PHERUSA (?) CÆRULEA, n. sp.

Colour of body a deep indigo-blue, appearing black when alive. Length about 5 mm. *Superior antennæ* about 4 mm. long, and considerably longer than the inferior; last joint of the peduncle with a secondary appendage consisting of a single joint and a terminal seta; flagellum about three times as long as peduncle and very-many-jointed. *Inferior antennæ* about two thirds as long as superior, and with the peduncle reaching slightly beyond the extremity of peduncle

of the first pair. The mandibles have an appendage. The gnathopoda are small and subchelate; the dactylos of the second pair is quite peculiar; it does not end in a claw, but in a finger-like setiform process. Pereiopoda very similar in form, the basa being progressively dilated; fourth pair the longest. Telson entire. Coxæ of the first four segments very deep, the 4th broader than the preceding three together.

*Hab.* Several specimens of this species were taken in a runnel of water on the Obelisk (or Old Man) Range in the interior of Otago, at a height of about 3000 feet. The stream was a little thing that one could have dammed with the hand, and running at such a slope that I can hardly imagine how the crustacea are not washed away by every shower of rain. The Old Man range is about 80 miles from the sea. The only other fresh-water amphipod found in New Zealand (excluding the subterranean forms found by Chilton) is *Calliope fluviatilis*, mihi, which is very common."

This paper will be published entire, with illustrations, in the Society's Transactions.

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A letter was read from Dr. C. S. Minot, of 25 Mount Vernon Street, Boston, Mass., U.S.A., calling attention to the Elizabeth Thompson Science Fund, for the advancement and prosecution of Scientific Research, and inviting applications for assistance from it.

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Mr. Howard Saunders exhibited an adult specimen of the Sooty Tern (*Sterna fuliginosa*) sent to him by Mr. A. C. Foot, of Bath, with the statement that the bird was caught alive about three miles from that city, on the 4th or 5th October, 1885, the weather being windy and the floods extending over the meadows. It was brought to Bath on the 6th October, and seen in the flesh by the Rev. Leonard Blomefield and the Librarian of the Bath Museum.

Only two examples of this species had as yet occurred in Great Britain. Its habitat was principally intertropical, but it bred as far north as the Florida Cays, and straggled northwards, generally in autumn, to the coasts of New England. Under the name of "Wide-awake Fair" its breeding-colony at Ascension was well known.

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The following papers were read:—

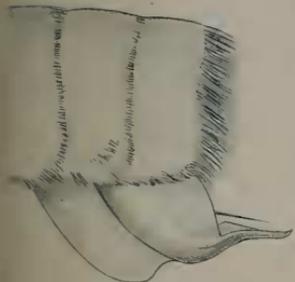
1. On Butterflies of the Genus *Parnassius*.

By H. J. ELWES, F.Z.S.

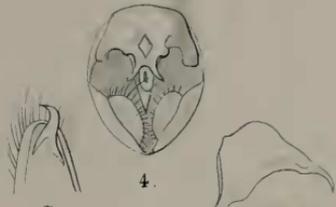
[Received January 19, 1886.]

(Plates I.—IV.)

Notwithstanding that the Butterflies of this genus have for years been especial favourites among entomologists, and that their countless variations have caused many pages of unprofitable descriptions to be written on them, yet our actual knowledge of their life-history is, with



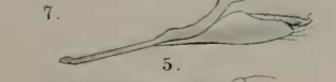
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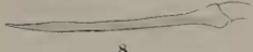
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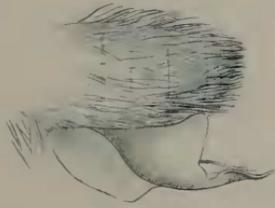
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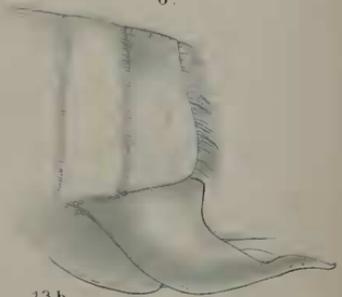
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13 a.



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13 b.



14 a.



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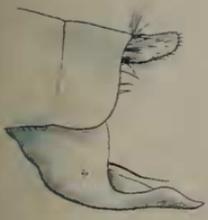


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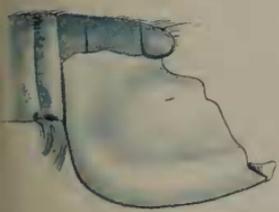
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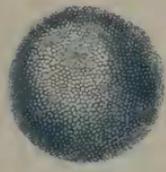
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THE CAMBRIDGE SCIENTIFIC INSTRUMENT COMPANY

STRUCTURE & DEVELOPMENT OF PARNASSIUS

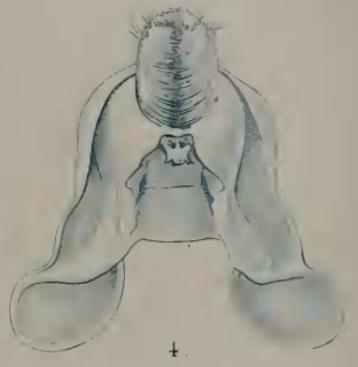




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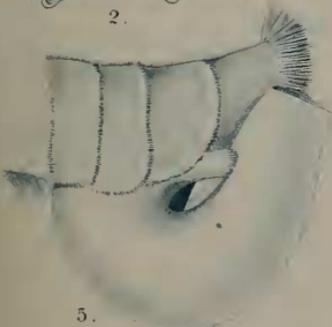
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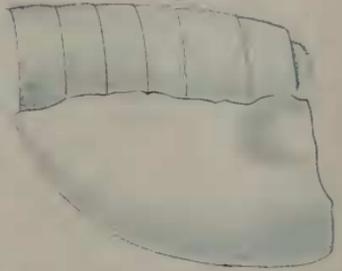
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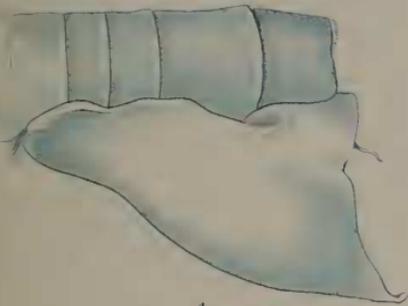


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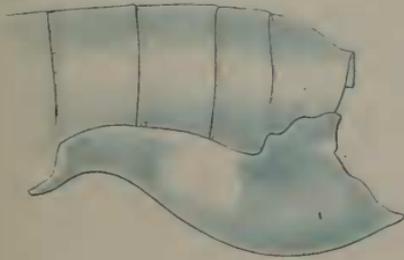




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the exception of two or three species, so slight that it would be quite premature to write a monograph of the genus. But, partly through the numerous scientific explorations which have been carried on in Russian Asia of late years, and partly owing to the high value placed on these Butterflies having encouraged the efforts of professional collectors in remote parts of Turkestan, so large a number of specimens have reached Europe during the last five or six years that a review of the genus is both possible and useful. The principal object, however, in my work has been to investigate the functions and structure of the horny pouch-like appendage which is found in the female sex of the genus, and which seems to have been almost entirely overlooked by most of those who have classified and described the species.

I had not appreciated the immense importance of this structure, as a specific and generic character, until I received two years ago, through the kindness of my friend M. Charles Oberthür, of Rennes, a specimen of the magnificent *Parnassius imperator* from East Tibet; but when I saw how strongly it resembled *P. charltonius* of West Tibet in everything but the form of the pouch, whilst this organ was remarkably different, I saw what appeared to me a structural character of the highest value, and was led to an examination of the whole genus, which, on account of the extreme tendency to variation in size, and in the number and colour of the ocelli and markings—which had previously been considered as the principal characters by which to distinguish the species—was in a most unsatisfactory state of confusion.

The result of my examination is here given; and I may say that, however faulty and incomplete it may be, I have taken every pains to bring it up to date, and have personally examined the principal collections, both public and private, in Germany, France, Russia, and England. I have thus been able to see, and to a certain extent compare, large numbers of almost all the known species, and though my conclusions may not be accepted by those whose interest and pleasure it is to multiply synonyms, and thus to increase the difficulty of the study of Lepidoptera, yet I believe that as far as it goes it is based upon facts alone.

My own collection, a part of which is now shown, contains about 400 specimens of the 23 species which I recognize in the genus, and includes both sexes of every described species except two. Though this number may seem large, yet I believe that it is not more than half of what would be required to illustrate perfectly such variable species as are most of the *Parnassii*, and though I have a long series of many, I have kept no specimens which are not necessary to illustrate some fact either of geographical distribution, of variation, or of range of altitude and season. And such I imagine should be the object of every scientific collector in any branch of natural history. We too often see, in British collections at least, a fixed number of specimens exhibited in order to complete a row; but it is evident that whereas in some species of restricted habitat and little or no tendency to variation, two or three pairs may be

ample, in another 100 pairs may be insufficient to illustrate all the points in the history of a species.

With respect to the development and function of the pouch in this genus, which appears to me interesting not only to lepidopterists but to all students of Biology, I must here acknowledge the assistance I have received from Mr. A. Thomson, of the Society's Gardens—who undertook and carried out in a most painstaking manner the observations on living insects, of which an account is given below—and especially to Mr. Salvin and to Prof. Howes, of the Biological Laboratory, South Kensington, who undertook the difficult and delicate task of dissecting and examining the specimens preserved by Mr. Thomson at the Gardens.

And though much remains to be done before we can say that we fully understand this intricate question, yet a distinct advance has been made on our previous knowledge, and certain facts which were previously doubtful or obscure have been proved. The first writer who seems to have paid much attention to this organ was Von Siebold, who published in the 'Zeitung für wissenschaftliche Zoologie,' 1850, iii. pp. 54–61, and reprinted in the 'Stettiner entomologische Zeitung' 1851, pp. 176–185, a long and most valuable paper on the subject, a *précis* of which, from an English translation kindly lent me by Mr. Gosse, I am here able to give:—

The first part is historical, and shows that though Linnæus, Latreille, and Schæffer had mentioned the existence of the pouch and described its form more or less incompletely in *P. apollo* and *P. mnemosyne*, no one had carried these observations any further. Ochsenheim accepts its existence in the female as a generic character of *Doritis*, and Boisduval separates *Doritis apollinus* from *Parnassius* because it has no pouch.

Siebold doubted whether the organ really formed part of the body, as he found that he could easily separate it in *P. mnemosyne*, and, with more difficulty, in *P. apollo*, as in this species it is glued more strongly by its base to the underside of the abdomen.

He then suggests that it originates during copulation, in these words:—"Probably from the male or female individual, at the anal region there is secreted a clammy coagulable fluid, poured forth during the close association of the genital organ of the male with that of the female, which, by coagulating and hardening, produces a firm and long-enduring union of both sexes. After the end of the copulative act, and after the complete severance of the sexes, there remains this coagulated substance as a sort of cast or impress of the hinder parts of the male in the vicinity of the sexual orifice of the female, a witness of the accomplished coitus." He then states that virgin females fresh from the pupa have no pouch, and says that Höger was mistaken when he suggested that the pouch was afterwards protruded from the body for the purpose of oviposition. He then goes on to state that a chemical examination of the substance of the pouch by Dr. Baumert showed that it had no affinity with the chitinous substance of the body of the insect, which was insoluble when treated with caustic alkali; whereas the pouch of both *P. apollo*

and *P. mnemosyne* dissolved when boiled in the same chemical, leaving only brown oily drops. The alkali was then saturated with mineral acid, but nothing organic was separated from it, whence we must conclude that the originally dissolved substance was destroyed.

Siebold compares the pouch of *P. hardwickei*, which he saw in the Vienna collection, with that of *P. mnemosyne*, from which, however, as I have afterwards shown, it is very different. He also compares the pouch of *P. delius* with that of *P. apollo*, and says that it agrees in colour, texture, and shape, wanting only the sharp keel. In this, however, he was mistaken, as I have never seen a specimen of *P. delius*, or of any species of this group, in which the keel was absent, though in *P. jacquemonti*, which Siebold could hardly have seen, it is so.

He then describes the observations of Herr Reutti, of Freiburg, who undertook the rearing of *P. apollo* from the larva in order to prove the correctness of Siebold's views. On May 29 he collected fifty larvæ, which had mostly undergone their last moult, on *Sedum album*. He describes them as being very troublesome to rear, because the larvæ, though feeding greedily when placed on the plants, would not return to the food of their own will, owing to the want of sunshine in a room of north aspect.

He succeeded, however, in rearing 11 larvæ, which went into pupæ under plants or stones, and in one case in an angle of the cover of the cage in a slight web of spun threads; "within this the larva hung by the hind feet in the manner of a *Vanessa*; the pupa, however, lay free in the web." Reutti succeeded in rearing four pairs of the butterfly, one of which, on July 17 at 1 P.M., united, and remained *in coitu* until late at night; next morning they were separate, and the female had a perfect pouch; but no observation was made of its formation.

Siebold thinks that the keel in the pouch of *P. apollo* is produced as follows: "By observing the male genital organs of *P. apollo*, it seems to me that the coagulating secretion is poured out under the two lateral valves, which, on the end of the abdomen of the male beneath, keep the proper genitals embraced, so that these latter, after coagulation of the pouch-forming secretion, are found in the interior of the pouch, whilst the valves are pressed against the outside of the vault of the pouch, and part of the coagulated matter stands out between them as the above-mentioned keel."

Lastly, Siebold quotes Kollar for an extraordinary story about the larvæ of *P. mnemosyne*, which are preserved in the Imperial Collection at Vienna, resembling those of *P. apollo* in habit, colours, markings, and which are "not seldom found on recently dead horses in the lower mountain valleys of Austria and Hungary"!!!

On the same evening that this paper was read, I had hoped that Prof. Howes would have been able to give us the result of his examination of the specimens preserved at the Society's Gardens as here-after mentioned; but Prof. Howes having been delayed by illness and press of other work, his observations will form the subject of a later

communication from him, and he is only able at present to supply the following note:—

“The assumption that the pouch of the female *Parnassius* performs a definite function after copulation, appears in all cases to have been, without doubt, suggested mainly by its scoop-like shape, no less than by its constant characters and relations and its persistence after coition. This assumption originated with Höger, who believed the pouch to have been concerned in oviposition, describing it, in fact, as a veritable ovipositor, ‘zuerst im Hinterleibe dieser Schmetterlinge fertig verborgen.’ V. Siebold<sup>1</sup> first successfully disposed of this view, and showed that the structure in question was a secretion, believed by him to be derived from the male, and to be functional in prolonging the coitus<sup>2</sup>. I cannot agree with him that this is the case, the adhesion of the copulating individuals being assured by the hook-like claspers of the male. The pouch is densest in the vicinity of the female genital orifice, and its detailed structure conforms internally to the ventro-lateral parts of the male genital funnel. In view of this, the fact that it is impossible, in dissection of specimens procured during copulation, to remove the pouch without bringing away the internal generative apparatus of the female, points, to my mind, to a direct connection between that apparatus and the pouch itself. It suggests the probability of an origin of the same from the body of the female, and not of the male as is generally supposed. I cannot accept the view ‘that the pouch is composed of hardened cases of adherent spermatophores,’<sup>3</sup> and the only supposition which seems to me thus far possible is that it represents a viscid secretion, poured out most probably by the female during copulation, which—instead of slowly disintegrating or otherwise disappearing, as do similar coagulable and non-coagulable secretions functional among other animals as accessories to the conjugative act—is hardened on exposure to the atmosphere. It persists as a cast of the male genital apparatus, which may be carried by the female until the day of her death, a token of the consummation of her existence<sup>4</sup>.

“The above remarks apply to *P. apollo*, one pair of which species, preserved during a copulation of 75 minutes’ duration, I have alone examined. My best thanks are due to Mr. Elwes for these specimens and others, upon which I hope shortly to be engaged.”

But though to Von Siebold the credit is principally due of calling attention to this organ, yet no one seems to have carried his observations any further, though Mr. W. H. Edwards, with Dr. Hagen’s assistance, gave a summary of Von Siebold’s paper in the ‘Butterflies of North America’ several years ago, and Dr. Burmeister has

<sup>1</sup> Zeitschr. f. Wissensch. Zoologie, vol. iii. 1851; also ‘Entomolog. Zeitung,’ same year.

<sup>2</sup> *Loc. cit.* p. 55.

<sup>3</sup> Macalister, ‘Introduction to Animal Morphology,’ vol. i. p. 412, 1876. Prof. Macalister informs me by letter that his material was in a “very dilapidated state.”

<sup>4</sup> Conf. v. Siebold, *l. c.* p. 56.

in the allied genus *Euryades* proved Von Siebold's ideas to be in the main correct.

Burmeister, in his 'Atlas de la République Argentine,' Livr. 1, p. 10, pl. 3, figures and describes the structure of the abdomen in *Euryades duponcheli* and *E. corethrus*, which is analogous to that in *Parnassius*.

He says that the copulation in *Euryades* is very protracted, and though he gives no details of the manner in which the appendages of the female are formed, yet he states that the secretion forming them proceeds from the male, in the same manner as in *Parnassius*. He does not, however, suggest any use for the appendages nor state whether there is any variation in them. From the figures it is clear that they are almost identical in the two species comprising the genus.

Dr. Hagen, in the 'Comptes Rendus Ent. Soc. Belgique,' vol. 18, p. lvi, says that he is convinced that the appendage of *Euryades* is an analogous structure with the pouch of *Parnassius*, and that the only difference is one of form, which may be easily understood if one allows that the fluid which composes it is emitted on the two sides during copulation.

Burmeister, in Stett. ent. Zeit. 1874, p. 427, says of *Euryades*, that he is convinced that the female appendages of this genus are not developed before copulation, and that the substance of which the apparatus is composed is completely homogeneous with that of *Parnassius*. He suggests that the secretion flows from the male during the act of copulation, and hardens afterwards in the form which it took during its exudation from the male's body.

Though there was every reason to believe that Reuti's observations, as far as they went, were accurate, yet wishing not only to understand more fully the manner in which the pouch was formed, but also its function in the life of the insect, I went in 1884 and 1885 to the Alps to study the question, where the insects are abundant; but owing to various difficulties, which are detailed in my account of the life-history of *P. apollo*, *delius*, and *mnemosyne*, I failed in observing for myself the necessary details. I was, however, fortunate in procuring through Herr Heine, of Leipzig, a number of pupæ of *P. apollo*, which were sent to the Insectarium of the Zoological Gardens, and have afforded ample details as to this species. Mr. Thomson's notes are here printed verbatim, but I was able to gather some further details which are worthy of note.

He found that *Parnassius apollo* requires about an hour after emerging from the pupa, in order to perfect and harden the wings, and that the colour of these is at first of a yellowish tinge, but soon fades to white when exposed to the sun. This yellowish tinge I may add is found in some very fresh examples of almost all the species, and may be taken as an indication that the insect is only just out of the pupa.

He found that the copulation of the sexes takes place immediately after the complete development of the insects, provided that the sun is bright and warm, but that on dull days the insects remain

torpid without flying; that the duration of the act is from  $3\frac{1}{2}$  to  $6\frac{1}{2}$  hours, but the pouch is developed in a much shorter time, thirty minutes in one case sufficing to make it visible to the naked eye. But my observations of *P. mnemosyne* make it evident that either that species differs from *P. apollo* in this respect, or that instances of imperfect copulation, not followed by the appearance of a pouch, may occur.

Mr. Thomson also proves:—That eggs may be and are sometimes laid before the completion of the act, and that they may be laid by pouchless females of *P. apollo*, as I found was also the case with *P. mnemosyne*. That laying continues for several days at intervals, the life of the female extending to at least a week, whilst the males appear completely exhausted by the act of copulation, and die in one or two days after it without flying much, though they remain lively and strong for several days before the act takes place. No attempt was made by virgin males observed by Mr. Thomson to mate with an already mated female, but my own observations in nature show that this is not the case in a natural state. The date of emergence from the pupa is usually two or three days earlier in the male than the female, and the proportion of males not much greater than of females. But in a wild state the proportion of males of both *P. apollo* and *P. delius* always seems to be much greater; and from the comparative rarity of the females in almost all the species of the *P. apollo* group this seems to be the case in other countries. But in the *P. mnemosyne* and *P. delphius* groups females, though occurring somewhat later, seem usually to be nearly as abundant as males.

#### *Notes on the Copulation of Parnassius apollo.*

By ARTHUR THOMSON.

“On the 18th of June, 1885, I received forty pupæ of *Parnassius apollo*, which had been sent to the Gardens by order of Mr. H. J. Elwes, F.Z.S., for the purpose of watching the perfect insects when copulating, and to endeavour, as far as possible, to throw some light upon the development of the ‘horny pouch’ with which the female is provided after copulation.

“How far I have been successful I must leave others to judge, but I wish to say that the fact of the female *Parnassius* developing such a ‘pouch’ after emerging from the chrysalis was quite new to me, so that I had no preconceived ideas upon the subject, and I have noted the facts just as they occurred.

“I first had a large gauze cage made, and placed in it six plants of *Sedum telephium*, the food of this species, and put in the insects as soon as they were ready, after emerging from the pupæ.

“The first and second copulations took place on June 27; the first pairing lasted from 11.10 A.M. to 2.25 P.M. = 3 hours 15 minutes, and the second pairing lasted from 11.30 A.M. to 3.0 P.M. = 3 hours 30 minutes. The ‘pouches’ in each case were perfectly developed, and the females began to deposit their eggs upon the gauze within five minutes of their separation from the males.

"Whilst the first pair were in copulation I made a sketch (as well as I was able) of the 'pouch' as it then appeared (fig. 1), a side view of the 'pouch' immediately after separation (fig. 2), a side view of the position of the female whilst laying her eggs (fig. 3), and a back view of the same (fig. 4)<sup>1</sup>. The 'pouch,' as then seen through a magnifying glass, appeared to be about  $\frac{3}{16}$  of an inch long and not quite an eighth of an inch broad, with a *very slight* central depression the whole length, of a dark green colour, and with very minute transverse corrugations. This I found, during the time I was watching them, to be a membranous covering attached to the abdomen of the *male*, containing a dark green fluid. This membrane entirely covered the true pouch of the *female*, as I observed that the male appeared to be able to contract it, and did several times, so as to expose the 'pouch' of the female, which was then quite white; and it has since occurred to me, that this exposure of the 'pouch' might be for the purpose of hardening it a little, as the 'pouches' of the females are *quite soft during copulation*, but soon harden after separation and exposure to the atmosphere, and this leads me to think that this membranous covering of the male is the mould in which the 'pouch' is formed during copulation. One thing, however, is certain, that the 'pouch' is developed entirely *during copulation*.

"The third copulation took place on the 28th of June, and lasted from 10.23 A.M. till 12.48 P.M.=2 hours 25 minutes. The pouch was developed. These specimens were dropped into spirits of wine 'in cop. '; the membrane of the male then began to contract by the action of the spirit, but the insects did not separate.

"The fourth copulation took place on the 28th of June, and lasted from 1.15 A.M. till 2.30 P.M.=1 hour 15 minutes; these specimens were then dropped into spirits. The 'pouch' was developed; and I may here mention as a proof that the 'pouch' has nothing whatever to do with oviposition, that the female of this pair laid an egg whilst 'in cop.'

"The fifth copulation took place on the 4th of July, and after the insects had been in copulation 30 minutes they were put in spirit. The 'pouch' was apparently developed.

"The sixth copulation took place on the same day; after being in copulation *ten* minutes the pair were put in a cyanide bottle and killed. They separated after death, but no sign of a 'pouch' was visible. These specimens were afterwards put in spirits.

"The seventh copulation took place on July 6, and after the insects had been in copulation about three hours, I separated them forcibly. The 'pouch' of the female was quite soft, and I pressed the keel gently with a pin to see if the impression would remain when the 'pouch' had hardened, and it has done so. I then examined the membrane of the male, and found that by squeezing the abdomen of the male, and holding up the membrane with a pin, a white opaque gelatinous substance issued from that part of the abdomen of the male where the *point* of the pouch of the female would be during copu-

<sup>1</sup> These drawings are not now published.

lation. Some of this substance I was able to pull out with a pin, but it began to harden immediately on exposure to the atmosphere, and became quite brittle, and of a yellowish colour. From this I am led to think that the male supplies the material of which the 'pouch' is made, and that the female has really very little to do with making the 'pouch' at all.

"Besides the copulations before mentioned, three others took place, two being remarkable for the time they lasted, viz. 6 hours 30 minutes, and 6 hours 25 minutes.

"So far as I have been able to see, the 'pouch' of the female is of no use whatever after copulation.

"Although the food-plant of this species was in the gauze cage, not one egg was laid upon it but all were laid upon the gauze."

Partly owing to the fact that nearly all the species were happily unknown to the older authors, and partly because no one has yet attempted to divide the genus, its synonymy and literature is much more simple than in some genera. Herrich-Schäffer, Oberthür, Felder, and Staudinger have all published more or less complete catalogues of *Parnassius*, of which the last is the most accurate and valuable for the European species known to him. The principal authors who have described the various species are Ménétries, Eversmann, and Gray; but I need not refer here to their various writings, which are cited under the various species they described. The characters upon which most, if not all, previous writers have principally relied for the definition of the various species, namely, the pattern of the markings and the number and position of the black or red spots and ocelli, are, however, far too variable in most cases to be trustworthy. A very uniform style of coloration and pattern prevails throughout the genus, and though the affinities of most of the species to each other are more or less traceable by these characters, yet I have preferred myself to trust to the much more permanent, invariable, and important characters of the antennæ, fringes, and pouches of the females. Though these characters are not absolutely invariable, yet, as far as I can see from the examination of large series, they are much more so than colours or markings; and the pouch alone is so good a structural character, as to be invaluable for the purpose of classification.

But I have not described the form of these pouches in words, because the illustrations make it unnecessary; and though I have not, as I should have wished, been able to figure the pouch in every individual species, with the corresponding organs of the male, on account of the excessive number of plates that would have been required, yet all the most characteristic and remarkable have been accurately drawn by Mr. E. Wilson, of Cambridge, on a uniform scale of  $\frac{1}{2}$ .

As far as I have observed, the difference between the clasping organs of the male in different species is trifling compared with the difference between the pouches of the female; and it will be a most

<sup>1</sup> Cf. note by Prof. Howes, above, p. 10.

interesting problem for the future to discover how the organs of such curious species as *P. acco*, *P. charltonius*, *P. imperator*, or *P. tenedius* are produced, and why insects so very similar in appearance as *P. jacquemonti* and *actius*, or *P. charltonius* and *imperator*, have such very differently shaped pouches.

The distribution of this genus is entirely confined to the Palæarctic region, and in this respect it is peculiar, among large and important genera, with *Melitæa* and *Erebia*, which have an almost exactly similar distribution, though *Erebia* is more arctic than either of them. In the Nearctic region, which, as I have before mentioned, can hardly be separated from the Palæarctic region on the ground of any peculiarity among the Lepidoptera, it is confined, as is *Erebia*, and, with trifling exceptions, *Melitæa*, to the Rocky Mountains and country west of them. It is most numerous represented in the mountain-ranges of Turkestan, Southern Siberia, and the Himalaya, having only three species out of 23 in Europe; none in North Africa; none within the Arctic Circle, though *P. mnemosyne* and *P. eversmanni* come within a few degrees of it.

Of all the sections into which I have divided the genus, only two, namely the *apollo* and *mnemosyne* groups, have a wide range, and only these two have developed any marked specific differences; all the rest of the groups, most of which are monotypic, being confined to limited areas in Central Asia. It is almost certain that several species remain to be discovered in the mountainous regions of Mongolia, Tibet, and North-western China; but many years must elapse before we can have any complete knowledge of the natural productions of these extremely distant, inhospitable, and elevated regions.

*Parnassius* in one respect is unique among Rhopalocera, namely, that though in a great part of its range a genus most characteristic of mountain-ranges, and most abundantly represented where, as in Ladak and the mountains of Khokand, the climate is of an almost Arctic character, yet it does not occur anywhere in the Arctic Regions. *Colias*, *Argynnis*, *Erebia*, and *Chionobas*, with which *Parnassius* is generally associated in Europe, Asia, and America, are all typically Arctic genera. Why, then, is *Parnassius*, which finds a home at as great an elevation as any other known butterfly, absent?

Though in Europe generally looked on as mountain butterflies, several of the species, as *P. apollo*, *mnemosyne*, *bremeri*, *eversmanni*, and *nomion*, are also found in low and wooded districts. *Eversmanni* is said to be an inhabitant of deep bogs. *Mnemosyne*, though ascending the Alps to 5000 feet or more in Western Central Europe, in Eastern Europe is found commonly in the steppes. *Apollonius* also occurs both in saline steppes and high mountains.

The following Table shows the general distribution of the species, but it must be understood that almost everywhere the species are found in somewhat restricted localities, and not generally through the country.

Name of Species.	Europe.	Caucasus.	Turkestan.	West Siberia.	East Siberia.	Himalaya and Tibet.	Japan and China.	U. S. America.
1. <i>P. apollo</i> .....	*	*	...	*				
Var. <i>hesebolus</i> .....	...	*	*	*				
2. <i>P. delius</i> .....	*	* <sup>?</sup>						
Var. <i>intermedius</i> .....	...	...	...	*	*			
Var. ? <i>corybas</i> .....	...	...	...	...	*			
Var. <i>smintheus</i> .....	...	...	...	...	...	...	...	*
Var. <i>hermodur</i> .....	...	...	...	...	...	...	...	*
3. <i>P. nomion</i> .....	...	...	...	...	*			*
4. <i>P. actius</i> .....	...	...	*	...	...	*		
Var. <i>discobolus</i> .....	...	...	*	...	...	...		
Var. ? <i>rhodius</i> .....	...	...	*	...	...	* <sup>?</sup>		
Var. <i>himalayensis</i> .....	...	...	...	...	...	*		
5. <i>P. honrathi</i> .....	...	...	*	...	...	...		
6. <i>P. davidis</i> .....	...	...	...	...	...	...	*	
7. <i>P. bremeri</i> .....	...	...	...	...	*	...		
8. <i>P. apollonius</i> .....	...	...	*	...	...	...		
9. <i>P. aeco</i> .. .....	...	...	...	...	...	*		
10. <i>P. simo</i> .....	...	...	...	...	...	*		
11. <i>P. jacquemonti</i> .....	...	...	...	...	...	*		
Var. <i>sikkimensis</i> .....	...	...	...	...	...	*		
12. <i>P. delphius</i> .....	...	...	*	...	...	...		
Var. <i>staudingeri</i> .....	...	...	*	...	...	...		
13. <i>P. stoliczkanus</i> .....	...	...	...	...	...	*		
14. <i>P. hardwicki</i> .....	...	...	...	...	...	*		
15. <i>P. charltonius</i> .....	...	...	...	...	...	*		
16. <i>P. imperator</i> .....	...	...	...	...	...	*		
17. <i>P. teneidius</i> .....	...	...	...	* <sup>?</sup>	*	...		
18. <i>P. mnemosyne</i> .....	*	*	*	...	...	...		
Var. <i>stubbendorfi</i> .....	...	...	...	...	*	...		
19. <i>P. glacialis</i> .....	...	...	...	...	...	...	*	
20. <i>P. evcrsmanni</i> .....	...	...	...	...	*	...	...	*
? Var. <i>felderi</i> .....	...	...	...	...	*	...	...	*
? Var. <i>thor</i> .....	...	...	...	...	...	...	...	*
21. <i>P. clodius</i> .....	...	...	...	...	...	...	...	*
22. <i>P. elarius</i> .....	...	...	* <sup>?</sup>	*	...	...	...	*
23. <i>P. nordmanni</i> .....	...	*	...	...	...	...	...	*

Europe has three species belonging to two groups.

Caucasus has three or four species belonging to two groups.

Turkestan has seven species belonging to three groups.

West Siberia has three or four species belonging to three groups.

East Siberia has six species belonging to three groups.

The Himalayas and Tibet have eight species belonging to seven groups.

Japan and China have two species belonging to two groups.

U.S. America have four species belonging to two groups.

Though the genus *Parnassius* has hitherto been included in the family of Papilionidæ, yet it seems to me worthy to constitute a separate family, comprising the genera *Eurycus*, which is confined to North Australia and New Guinea, *Euryades*, which is found in the Argentine States, and *Lühdorfia*, which is an inhabitant of the southern coasts of Amurland and probably North Japan. In making this proposal, I do so on the ground that the extraordinary appendages of the female abdomen, which are found in these four genera alone among the Rhopalocera, and which, though very different in structure, are apparently analogous, afford a character of at least as much, if not of greater, value in classification than the characters drawn from legs, venation, antennæ, or larval structure.

And though my ignorance of larval characters among Lepidoptera generally, makes me unable to form an opinion as to their value for purposes of classification, yet they apparently lead to the grouping of very dissimilar forms. Mr. W. H. Edwards remarks on the subject in 'Papilio,' vol. iii. p. 159:—"I do not think, judging from the egg and young larva as I know them, and by the mature larva and pupa as figured in books, that *Parnassius* has any right among the Papilionidæ. Under a system in which the preparatory stages were considered—and in the future we shall have to come to that—it would stand a long way from the Papilionidæ. The egg of *smithus* is like *Lyceena*; of *baldur* like *Chrysophanus*; the young larva is like some Nymphalidæ (and perhaps Erycinidæ), the mature larva more like a Heterocerous moth (in all but the tentacles), and the chrysalis like a Hesperian, or also perhaps some moths."

In 1870 the late Edward Newman published in the 'Entomologist' a system of classification for Butterflies, in which he places *Parnassius* in the second division of the Rhopalocera, which he called *Celantes*, forming with *Doritis* the Group A, Bombycifformes. The division is defined as follows:—" *Celantes*, or those in which the larvæ, prior to changing to pupæ, envelope themselves in a silken follicle or cocoon more or less compact; the pupæ are generally without angles, like those of the genus *Chelonia* among the Sessiliventre." The Bombycifformes are those in which the head of the larva is smaller than the second segment, and the body is altogether that of the *Bombyces*. The *Capitati*, which form the second section of this division, are the Hesperidæ, in which the head of the larva is larger than the second segment.

Now, without expressing any opinion on the propriety of such a classification, it is clear that any arrangement which depends on larval characters must in the case of very many genera be conjectural. Newman criticizes the classification of Kirby's catalogue very unfavourably, saying that his subfamily Papilioninæ is entirely opposed to his own idea of natural arrangement. The genera Kirby included are *Mesapia*, *Calinaga*, *Hypermnestra*, *Ismene*, *Doritis*, *Parnassius*, *Eurycus*, *Euryades*, *Sericinus*, *Thais*, *Teinopalpus*, *Papilio*, and *Leptocircus*.

Staudinger includes *Parnassius* with *Papilio*, *Thais*, *Ismene*, and *Doritis*, in his family Papilionidæ, which comes at the head of the

class, instead of last but one as in Kirby's catalogue, whilst Herrich-Schäffer places *Parnassius* as the second section of the genus *Doritis*.

*Synopsis of the Genus.*

Fam. PARNASSIIDÆ.

Imago imagini Papilionidarum similis quoad alarum structuram, sed fœmina nupta sacculo corneo ad ventrem extremum instructa. Pupæ haud suspensæ. Larva distincta, larvis Heterocerorum affinis.

Gen. 1. PARNASSIUS, Latr.

SECT. I.

- |   |   |
|---|---|
| 1. APOLLO, Linn. ....                             | Europe (excl. reg. pol. et Anglia);<br>Armenia; Caucasus.           |
| <i>a.</i> Var. <i>hesobolus</i> , Nordm.....      | Siberia, Altai, Alatau, Ural, Caucasus.                             |
| <i>v.</i> major, ♂ albidior, ♀ obscurior.         |   |
| transitus ad <i>hesobolus</i> .....               | Tarbagatai ( <i>vide</i> Stgr.), Cauc. Arm.<br>( <i>vide</i> Rom.). |
| 2. DELIUS, Esp. ....                              | Alps Eur. cent., Caucasus?  |
| <i>a.</i> Var. <i>intermedius</i> , Mén. ....     | Altai, Sib. cent. et or. (Irkutsk).                                 |
| <i>sedakovii</i> , Mén.                           |   |
| <i>b.</i> ? Var. <i>corybas</i> , Fisch. de Wald. | Kamsehatka; ? Sib. s. or.   |
| <i>c.</i> Var. <i>smintheus</i> , Doubl. ....     | Rocky Mts. U.S. Am.; Colorado, &c.                                  |
| <i>d.</i> ? Var. <i>Behrii</i> , Edw.             |   |
| <i>e.</i> Var. ♀ <i>hermodur</i> , H. Edw.....    | Rocky Mts., Brit. Columbia, Montana,<br>&c.                         |
| major obscurior.                                  |   |
| ? transitus ad <i>discobolus</i> .                |   |
| 3. NOMION, Fisch. ....                            | Prov. Amur, Alaska.   |
| <i>a.</i> var. ? minor .....                      | Brit. Columbia.   |
| (transitus ad <i>smintheus</i> ?)                 |   |
| 4. ACTIUS, Ev. ....                               | Alps of Turkestan.  |
| <i>a.</i> Var. <i>discobolus</i> , Stgr. ....     | Alatau, &c., Alps of Khokand.                                       |
| major obscurior (an <i>delius</i> referendus?)    |   |
| <i>b.</i> Var. <i>rhodius</i> , Honrath.....      | Prov. Ladak, Alai, Khokand.   |
| ? = <i>epaphus</i> , Oberthür.                    |   |
| (minor, al. post. punct. bas. eocincis.)          |   |
| <i>c.</i> Var. <i>himalayensis</i> , Elwes.....   | Prov. Lahoul, &c.; N.W. Himalaya,                                   |
| <i>jacquemonti</i> , Blanch. et<br>Moore in part. | Alps, 11000–16,000 ped. alt.  |
| (? an <i>delius</i> referendus.)                  |   |
| 5. HONRATHI, Stgr. ....                           | Alps of Samarkand, Bokhara, &c.                                     |
| <i>corybas</i> , Ersch.                           |   |
| 6. DAVIDIS, Oberthür .....                        | Mountains of N. China.  |
| (♀ mihi naturâ ignota incertæ sedis.)             |   |
| 7. BREMERI, Brem.....                             | Prov. Amur.   |
| 8. APOLLONIUS, Ev. ....                           | Prov. Kuldja, Khokand, steppes and<br>mountains.                    |

SECT. II.

- |                           |                     |
|---------------------------|---------------------|
| 9. ACCO, Gray .....       | Prov. Ladak, Tibet. |
| †10. SIMO, Gray. ....     | Prov. Ladak.        |
| (♀ ignota incertæ sedis.) |                     |

SECT. III.

- |   |  |
|---|--|
| 11. JACQUEMONTI, Boisd. ....              | Prov. Ladak, N. W. Himalaya, supra<br>? = <i>epaphus</i> , Oberthür.<br>14,000 ped. alt. |
| Var. ? <i>a. sikkimensis</i> , Elwes..... | Alps of Sikkim, Tibet.   |
| (miuor, orientalis).                      |  |

## SECT. IV.

12. DELPHIUS, Ev. .... Mont. Tarbagatai, Altai, &c.  
 Var. ? *a. staudingeri*, Bang-Haas.... Mont. Bokhara, Khokand, &c.  
 13. STOLICZKANUS, Feld. .... Prov. Lahoul, N.W. Himalaya, Ladak.

## SECT. V.

14. HARDWICKEI, Gray ..... Himalaya 6000-14,000 ped. alt.  
 Ab et var. ♀ *vix* nom. conserv. Prov. Ladak.  
*charino*, Gray (obscurior).

## SECT. VI.

15. CHARLTONIUS, Gray ..... Prov. Lahoul, N.W. Himalaya.  
 Prov. Ladak, supra 11,000 ped. alt.

## SECT. VII.

16. IMPERATOR, Oberthür..... Ta-t sien-lo, Tibet or.

## SECT. VIII.

17. TENEDIUS, Ev. .... Sib. cent. mer., prov. Amur sup.

## SECT. IX.

18. MNEMOSYNE, Linn. .... Europe (excl. reg. pol. et Anglia),  
 Asia occ. et cent.  
 Var. *a.* ? *nubilosus*, Chr. .... Armenia, Persia bor.  
 Var. vel transitus ad *stubbendorfi*.  
 Var. *b.* ? an bona sp. *stubbendorfi*,  
 Mén. Prov. Amer. sup. et inf.  
 Var. *c.* vel trans. ad *glacialis* ..... Corea.  
 19. GLACIALIS, Butl. .... Japan.  
*etrinarius*, Motsch.  
 20. EVERSMANNI, Mén. .... Prov. Transbaikal, Amur sup.,  
 Prov. Alaska.  
*a.* Var. ? *felderi*, Brem. .... Prov. Amur cent.  
*b.* Var. ? *thor*, H. Edw. .... Yukon River, N.W. America.  
 21. CLODIUS, Mén. .... Mont. et litt., N.W. America.  
*a.* Var. ? *menetriesi*, H. Edw. .... Mont. Sierra Nevada, California.  
 22. CLARIUS, Ev. .... Mont. Altai ?, Tarbagatai.  
 23. NORDMANNI ..... Mont. S.W. Caucasus, Daghestan.

The two species marked † are only provisionally placed in the sections of the genus, as the female pouches are unknown. The varieties marked with a ? are those which do not seem from my present knowledge to be sufficiently well marked to be always recognizable.

## PARNASSIUS APOLLO, Linn.

This is the best known and one of the most widely distributed species of the genus, and is found in almost all the mountain districts of Central and Southern Europe, from about 1000 up to nearly 6000 feet in the Alps, and in many parts of Northern and Eastern Europe at quite low elevations; in the Caucasus according to Wagner up to 8000-9000 feet, in Southern Sweden and Norway, in Finland close to the sea-coast, in the hilly sandy pine-forests of the Lower Ural and Central Russia, in the higher mountains of Spain, Greece, and Asia Minor, and in some of the mountain-ranges of Northern Turkestan and the Altai, though its distribution in Asia is not yet perfectly known.

In some parts of Germany it has become extinct of late years,

probably owing to the number of collectors, but in most of its habitats it is a common, and in many of them a very abundant insect.

It commences to fly in some of the warmer valleys of the Alps in May; I have taken it myself on May 25th on the Canton Wallis at about 2500 feet, but this is a local occurrence, as Meyer-Dür gives June 17 as the earliest date of its appearance, and on the same day I found half-grown larvæ at the same elevation. It continues to fly for six weeks or two months, and fresh specimens may sometimes be met with up to the first week in August. I think that elevation has not so much to do with the time of its appearance as other circumstances. I found fresh specimens in the Lower Bregalia Valley near Chiavenna at 1200 feet in the end of June; and six days later I found it close to Pontresina, in the Engadine, at nearly 6000 feet. It prefers warm rocky slopes facing south and west, and is rarely found in Switzerland on a north exposure, or in woods. Meyer-Dür says that it seems to be wanting on the "Urgebirge," and is only local on the "Molasse" formation.

The flight of the insect is strong and sailing, but not rapid, and is continued from eight or nine in the morning till four or five in the afternoon. The females always appear in much smaller numbers than the male, fly less, and settle more often; with practice they may be distinguished on the wing. I am not aware that the insect has been bred in confinement from the egg, nor can I say with certainty whether the eggs are hatched in autumn or spring; but I believe that some part of the larval stage is passed in autumn<sup>1</sup>. The larvæ feed up in spring on the young leaves of *Sedum telephium* and *Sedum album*, and go into the pupa stage about fourteen days previous to the appearance of the perfect insect. According to Reutti they feed only during sunshine, and I found them generally two or three together on hot rocks where the food-plant was abundant. When touched they curl up and unroll with strong convulsions, and if well grown and healthy will live two or three days in a closed box, as the larva and pupa were drawn by Miss F. Woodward from specimens which I sent alive by post from Brieg in Switzerland to England. I believe that the females in this species, as in others, are almost invariably mated very soon after their emergence from the pupa, as specimens in which the pouch is not developed are but seldom found. I am not able to say whether in a state of nature the eggs are laid on the food-plant or not, but, according to Mr. Thomson, this is not the case in confinement.

The Rev. A. E. Eaton, in Ent. Mon. Mag. xix. p. 89, gives the following note on stridulation in the female of *P. apollo*:—"In the evening of July 23rd, whilst reclining on the grass near Bannio, Val Anzasca, a rustling as of a lizard or snake close to the back of

<sup>1</sup> W. H. Edwards in 'Papilio,' vol. iii. p. 159, says:—"But G. M. Mollinger writes me that the eggs of *P. apollo*, in Switzerland, hatch late in the fall, and the young larvæ hibernates; awaking in early spring, and eating the leaves of *Sedum*, not the flowers."

my head made it desirable to look round to see what was going on there; an apparently drowsy *P. apollo*, hanging by her fore feet to a composite flower, was slowly flapping her wings, and scraping the hinder pair with her four posterior legs, which were thrust backwards simultaneously each time that the wings opened. Obstruction to the movement of the fore wings caused no hindrance to the production of the sound, but when the hind wings also were held firmly between the finger and thumb, the noise ceased. The insect became so wide awake at this stage of the proceedings, that no further observations could be made, but it seemed probable that friction of the spines of the tibiæ and tarsus over the wing-veins largely contributed to the vibration of the wing-membrane."

The usual manner of pupation of *P. apollo* is described as being in a slight silken web among leaves, and this is confirmed by Miss F. Woolward, to whom I sent living larvæ to be figured. She says: "The larva did not hang itself up in any way, and the pupa is too fat and heavy for this to be likely. The way in which the larval skin was slipped off would seem to make it impossible. The larva had a very scanty supply of silk, which it spread about at the bottom of the box, making no attempt to enclose itself closely." Tachler, however, in 'Bericht der St. Gallischen Gesellschaft,' 1869-70, p. 87, says that "two larvæ of this species, instead of pupating in a light web among leaves, as is generally said to be the case, went into pupa hanging to the gauze of the cage in which they were confined." He thinks that this is a most abnormal occurrence, and perhaps the observation requires confirmation. These two larvæ remained seventeen days in pupa, and took two hours after emerging before the wings were fully formed.

The variation which exists in this species is very great, both in size and in the number and colour of the ocelli.

The largest female that I have is of the variety *hesebolus*, Nordmann, from the Transili mountains, which measures 3.5 m. across the wings. Another, from the Thian Shan, resembles it in size and colour. These females and those from the Ural are much more overlaid with black scales on both fore and hind wings than ordinary European specimens, but I have a female from the Jura almost as dark. A male from the Ural of the same variety measures 3.6, whilst eight males from the Altai measure from 3.1 to 3.3 across. These males are all more creamy in the ground-colour of their wings and less overlaid with black scales than Swiss specimens, showing that the causes which have induced the change of colour have acted on the sexes in opposite directions. Seven specimens from Eperies in North Hungary vary from 2.8 to 3.2; seven specimens from Norway and Sweden are from 3.2 to 3.3. The largest Swiss specimens I have are from Brieg and measure 3 to 3.1, whilst those from other parts of the Alps and Jura do not exceed 2.8, and I have one from Dourbes only 2.1 across the wings.

Specimens from the Sierra Nevada of Andalusia have the ocelli yellowish instead of red, and this occurs rarely elsewhere. One or two red spots beyond the cell of the fore wing as in *P. delius* occur

as a rare aberration in *P. apollo*, and the large ocelli on the hind wing are sometimes all red without white in the centre.

The variety named *P. hesebolus* by Nordmann, according to Alpheraky's notes on the Butterflies of Kuldja and the Thian Shan, is found from the end of May to about the 7th of August, between 3500 and 9000 feet. The difference between this form and *P. apollo* of the Alps consists in the greater size of both sexes, and the whiter colour of the wings in the male, whilst in the female the reverse is the case, so that the difference in colour between the sexes is greater in this variety than in the typical *P. apollo*. *P. hesebolus* appears to be the prevailing form from the Ural Mountains eastwards, though in the Tarbagatai Haberhauer found a form more like the Swiss one. In the Caucasian province the Grand Duke Nicholas says that "the var. *hesebolus* is found in the same places as *P. apollo* and many specimens show the transition from the type to the variety." In the Carpathians, near Eperies, the form found is more like *P. hesebolus*; whilst in the Jura, according to Meyer-Dür, the *P. apollo* can always be distinguished from those of the Alps by their duller, more yellowish ground colour of the wings.

Though *P. apollo* is sometimes found flying at the same place and time as *P. delius*, I have never seen a specimen which could be certainly looked upon as a hybrid. Dr. Christ of Basle has one which may be such; but the antennæ seemed to me to resemble those of *P. apollo*. Meyer-Dür quotes Meissner to the effect that a hermaphrodite of this species was taken on Oct. 10, 1816, on the hill of Tourbillon, near Sion in Wallis. He describes it as follows:—

"The right-hand side is female, the left male; the two wings of the female side are longer and broader, the red ocellus larger than on the male side, the right antenna is also longer and stronger. The abdomen has only in the middle somewhat longer hairs. But what proves the hermaphroditism most remarkably is the apex of the body, which not only has the horny pouch peculiar to the female in this family, but also the male organ clearly projecting."

I have seen in the collection of Herr Röder, at Wiesbaden, a hermaphrodite of *P. delius*, obtained from the late Dr. Settari of Meran, which has the left-hand wings perfectly female, and the right male; the left side of the body is also less hairy than the right, and though there is no clearly developed pouch, there are indications of hermaphroditism.

The distinguishing characters between *P. apollo* and *P. delius* are in typical specimens clear enough and are enumerated by Meyer-Dür on page 18 of his 'Butterflies of Switzerland;' but the only points which seem to be in all cases absolutely reliable are the hairs of the body and the antennæ, which on comparison show well-marked and constant difference.

#### P. DELIUS.

*Parnassius delius*, Esp. pl. 115, fig. 5 (1790?).

*P. phœbus*, Prun. Lep. Ped. p. 69 (1798).

Var. *intermedius*, Mén. Enum. i. p. 72 (1855); Stgr. Stett. Ent. Zeit. 1881, p. 256.

*P. sedakovii*, Mén. l. c. p. 71, pl. i. fig. 1.

Var. *corybas*, Fisch. Ent. Russ. p. 11, pl. vi. figs. 1, 2 (1822).

Var. *smintheus*, Doubl. Gen. Lep. pl. iv. (1847).

*P. sayi*, W. H. Edw. Proc. Ent. Soc. Phil. ii. p. 78 (1863); Edw. Butt. N. Am. i. pl. vi. (1872).

Var. *behrüi*, W. H. Edw. Trans. Am. Ent. Soc.; Butt. N. Am. vi. fig. 3 (1870).

Var. ♀. *hermodur*, H. Edw. *Papilio*, i. p. 4 (1881).

If this species is considered in a narrow sense as a purely European insect, its range of distribution is somewhat limited; but if the innumerable forms and varieties which occur in Asia and in the Rocky Mountains of North America—and which, as far as I am at present able to judge, have no constant structural characters differing from each other or from *P. delius*—are treated, as I think they should be, as forms of *P. delius*, then it is the most widely distributed species of the whole genus.

For the present, however, I will only give what I have been able to discover with regard to its life-history in Europe, where it is confined to the higher Alps of Switzerland, Tyrol, and Styria. According to Nordmann, it is also found in the mountains of Adshara in the Caucasus; but as neither Lederer nor the Grand Duke Nicholas Romanoff include it in their lists, I can say nothing as to this habitat. The species seems to be found more locally in the Alps than *P. apollo*, but is in many places abundant. I have always found it commonest in localities between 4500 and 7500 feet elevation, where a mountain stream had spread out into wide channels and formed rapid shallow brooks, bordered by a luxuriant growth of *Saxifraga aizoides*, which, according to Zeller's, Anderegg's, and my own observations, is the food-plant of its larva. Zeller, in Stett. ent. Zeit. 1877, p. 279, describes the larva as being in every way extremely like that of *P. apollo*, but as having yellowish, not orange antennæ; the pupa also resembles that of *P. apollo*.

It has been supposed that the larva and pupa of this species are able to exist under water, for a short time at least, and this, according to Zeller, must certainly be the case; the plant on which the larva feeds is always close to the water, and the sudden rise of a mountain stream, which must often occur, would drown them if they were unable to endure the bath. I have seen, near Bergun, a freshly emerged male, the wings of which were not yet dry, sitting on a plant of *Saxifraga aizoides* within a few inches of the water, and I have never seen the female settle on any other plant, though the male will on dull days rest on grasses and flower-heads.

Zeller says that he found the larva creeping over slimy wet ground without being in the least smeared or wetted; and Herr Anderegg, who takes the insects abundantly in Wallis, has assured me that he never saw it on any other plant but *Sax. aizoides*.

I visited a favourite haunt of this species with his son on July 1st,

1884, in hopes of being able to find larvæ or pupæ, but was disappointed in this, as on other occasions, though I took many males and several freshly emerged females. One pair were taken in copula at about 11.30 A.M., but separated in the net, and the female pouch was developed and hard, leading me to suppose that it was not the copulation of a virgin female, or that the act was already complete when I found them. The males flew backwards and forwards over a space of about 200 yards by 40, where their food-plant was most abundant; but unless chased flew at a slow pace, and frequently settled; the females flew but seldom, and settled for several minutes at a time on the plants of *Saxifraga*. I did not observe them in the act of laying, though eggs were visible externally in one or more specimen. The egg appears identical with that of *P. smintheus*, figured by Edwards in the 'Butterflies of North America.'

I returned to Brieg in May 1885, hoping to find the larva in the same place; but in this season the snow was still unmelted on May 26th, and lay two feet deep over the place where the butterfly had been common on July 1st in the previous season. This leads me to think that *P. delius*, like *P. apollo* and probably *P. mnemosyne*, passes some parts of its larval existence in the autumn, and remains dormant under the snow during 6 to 8 months, according to the elevation. I have found the butterfly as early as the end of June, both near Bergun and at Pontresina, and it may be found at higher altitudes up to 7000 or 8000 feet throughout July and August.

The variation to which this species is subject consists principally in the number and size of the red ocelli. The male has sometimes one, but usually two, red spots on the fore wing beyond the cell: the one on the costa is almost always present, and there is sometimes a black, and very rarely a red spot as well, near the middle of the hind margin of the fore wing. The fringe of the wings is sometimes plain white, and sometimes more or less distinctly marked with black at the end of the veins.

In the variety *intermedius*, from the Altai Mountains, these black markings on the fringe are much more regular and constant. In female specimens, as in the American form *smintheus*, there are generally two, sometimes one, and rarely three, red spots beyond the cell. In one specimen in my collection, and in one figured by Meyer-Dür, these three spots are almost confluent, forming a short bar edged with black.

The size of Swiss specimens varies from 2.50 to 1.80 inches; the Altai specimens average about 2.25; in American specimens the largest I have are of the so-called var. *hermodur*, from the Rocky Mountains of British Columbia, which are 2.40 to 2.50 inches across the wings, and the smallest, from Colorado, measure 2.10 to 1.80 inches.

With regard to the American form *smintheus*, such a full and excellent account of its habits has been given by Mr. W. H. Edwards in Butt. N. A. vol. i. pp. 21-26, that I need say but little; a further account of its habits as observed in the Judith Mountains,

Montana, by Mr. Courtis, is so interesting that I copy it from 'Papilio,' vol. iii. p. 158.

Mr. W. H. Edwards is here speaking of *P. smintheus*, var. *hermodur*, H. Edw., and says:—"These Montana examples of both sexes are very large, considerably beyond the average of *smintheus* from Colorado, some males and females reaching 2.70 inches. Several of the females are very black, there being little of the yellow-white ground left, and that principally in cells of primaries and on disks of secondaries. The red spots are of extraordinary size. I should have taken the female for a distinct species had not the male been so like and often indistinguishable from the Colorado males of *smintheus*, though larger. Some of them have the spots orange as in var. *behrii*.

"Several of both sexes I cannot distinguish from a pair of *P. intermedius* sent me by Dr. Staudinger as *Ménétries' species* from Siberia. These are the examples which are not melanic, and in which the marginal borders of both wings are transparent. I have a female of the same form taken on Mt. Bradley, California, by Mr. James Behrens<sup>1</sup>.

"Mr. Courtis at my suggestion shut up some females with *Sedum*, on which *smintheus* has been known to lay, and obtained 140 eggs. Mr. Courtis says, 'Most of these eggs came from females that mated after I caught them. The others would not lay, although I kept them shut up with several males until they nearly starved.'"

This is a most curious fact, as I found that *P. mnemosyne*, and Mr. Thompson found that *P. apollo*, mated freely in captivity; but Mr. Edwards says this is the first instance he has heard of in which butterflies have mated in captivity.

"Mr. Courtis goes on to say:—"The virgin females seemed to have the end of abdomen a light green horn instead of black, but after mating I noticed they turned black.' This seems to throw doubt on either Mr. Courtis's accuracy of observation, or to prove that the development of the pouch is not as in *P. apollo*. He goes on to say:—"I think they lay on the roots of plants, as the females always drop to the ground, climb up a stalk, and fly away. Those in confinement climbed sticks and window frames, laying eggs as they went. They curved their bodies round and put an egg on whatever they touched, except the *Sedum*; I made one lay on it by keeping her moving from one piece to another, but she seemed much excited, and as soon as I put her on grass and sticks she laid every few minutes.' In a later letter, 5th of August, Mr. Courtis writes, 'I noticed a female *Parnassius* alight on a piece of *Sedum*, drop to the ground, climb up and lay an egg either on the leaves or roots or on the ground. I could not find the egg, though I saw her go through the motion of laying.'"

Mr. W. H. Edwards has tried without success to breed *P.*

<sup>1</sup> I have received a pair from this locality, through the kindness of Mr. H. Edwards, and can only say of the female that I can hardly distinguish it from small examples of *discobolus* from Turkestan. The difference between the two sexes is most marked, the male being very like those from the Altai Mountains.

*smintheus* from the egg in Virginia. He states that the eggs hatched in the last days of winter, but will not eat *Sedum* leaves. He is certain that the eggs of this species do not hatch naturally till spring. He says that the newly hatched larvæ are most singular creatures, bearing no resemblance to any members of the Papilionidæ which he has seen. They are thickly studded with small tubercles in rows, and each of these gives out several short curved black hairs. They look something like caterpillars of *Argynnis*, but are different from these also.

Reakirt, in Proc. Phil. Ent. Soc. vi. p. 129, describes "eight very closely allied, but perfectly distinct and seemingly constant forms" of *P. smintheus*. He says:—"I think it highly probable that both *P. smintheus* and *P. nomion* are derivatives from the same parent stem, the former being yet in process of segregation, while the latter, most probably the older form, has passed through its transitional stages, and now presents only constant specific diagnostics. The chain of closely linked varieties of *P. smintheus*, of which the highest (*sayi*) approximates to *nomion*, would seem to corroborate this supposition." He goes on to describe a remarkable female form, and says that the only apparently constant diagnostic which he has detected in the species is the seemingly regular situation and form of the four basal spots on the under surface of the hind wings, in which it differs strongly from *nomion*, the only species he knows which closely approximates certain forms of the male and female.

"Mr. Ridings captured this fine species in July, solely within the mountain districts, usually when settled on the flowers of some tree, and always near the edge of a watercourse. It is abundant, but of difficult capture, not only from the natural obstacles interposed, but also from its very high and quick flight, this commonly rauging from four to eight yards above the head."

The form figured and described by Ménétries as *sedakovi* (Men. Enum. p. 71, t. 1. fig. 1), from Irkutsk, of which I have seen the type, is very like some of the Altai specimens, as are some of those from Kamschatka; whilst what was described as *corybas* by Fischer, from the same country, which I have also seen in the St. Petersburg Museum, are more like European specimens. I also possess a specimen which I can only refer to this species, from Kodiak in the North Pacific. There is evidently much to learn as to its distribution and variation in Eastern Asia, cf. Stett. ent. Zeit. 1881, p. 275.

Zeller, reviewing Edwards's 'Butterflies of North America' in Stett. ent. Zeit. 1874, pp. 433, 434, says that *smintheus* certainly belongs as well as *intermedius* to *P. delius*, and quotes Zincken to the effect that a beautiful drawing of female *P. delius* taken near St. Peter and Paul in Kamschatka by Dr. Langsdorf in 1804, does not show the least difference from Swiss specimens.

Zeller, in the same journal for 1872, p. 119, quotes Dietze to the effect that the eggs of fresh specimens of *P. delius* found on the Splügen pass on August 14, hatched in 14 days under the heat of an Italian sun. This seems to prove what I have before suggested, that *P. delius* must pass a considerable part of its larval existence in autumn.

## P. NOMION.

*Parnassius nomion*, Fisch. de Waldh. Ent. Russ. ii. p. 242, pl. 6 (1823-4).

This species, though at first sight very like *P. apollo*, may be certainly and constantly distinguished by the fringes of the wings, which are conspicuously chequered black and white; whilst in *P. apollo* this is never the case to the same extent, though some specimens have a tendency to it. The pouch also (though of the same general form) is black, more lengthened behind, and set on at the end, and not underneath the abdomen; the antennæ, the clothing of the body, and the general pattern of the markings are very similar.

I am not aware that the geographical range of the two species anywhere meets, *P. nomion* first appearing in the mountains of Dahuria, whilst *P. apollo* seems to go no farther east than the Altai Mountains; but these ranges on the Siberian frontier are but little known.

*P. nomion* appears to be common in the valley of the Amur, at Raddefskaia and Khabarofka, and Christoph found the larva feeding on a yellow-flowered *Sedum* near Vladivostock. According to Ménétries *P. nomion* is found near Irkutsk and at Kiachta, and I have seen a specimen from this locality in Dr. Fixen's collection.

Bremer says that it is found on the north side of Lake Baikal on the Onon river, and on the Ussuri between Noor and the Ema; the largest and finest specimens are from the Bureija Mountains, and farther west they become smaller.

M. Charles Oberthür says in a letter that he has received *P. nomion* from the Abbé David, who found it in the mountains of North China; he has also very curious specimens from Sidemi in Mantchuria taken by Jankowsky, which resemble the *P. nomion* of California, of which he has also an authentic specimen from the collection of Boisduval. This is probably the one mentioned by Boisduval in his list of the Butterflies of California. With regard to the occurrence of the species in N.W. America, there is, however, some doubt, for though Mr. H. Edwards says it has been taken in Alaska, and that he has seen a specimen in a collection from the Cariboo mining district in British Columbia, whilst Mr. W. H. Edwards includes it in his catalogue as from Alaska and Sitka (coll. Behr), yet I have never seen or heard of any true *P. nomion* in the numerous collections made in the Rocky Mountains of late years.

I have, however, a female specimen of *P. smintheus*, var. *sayi*, which might very well be considered as a small form of *nomion*, and I am not able to find any good character by which to separate it.

Indeed, it is quite possible that *P. nomion* represents *P. smintheus* on the North-western coasts of America, and that Mr. Reakirt's idea, *cf. supra*, that they have sprung from the same stock, is a correct view, though it would be a very curious fact in distribution if it was found that the two species come together in N.W. America, whilst in North-east Asia, as far as one can judge, from the very scanty materials which exist, *P. nomion* and *P. delius* remain distinct.

*P. nomion* varies considerably, but not so much as some species of

the genus: a fine female specimen from Dahuria in the St. Petersburg Museum has the fore wings almost free from white scales and the cell yellowish. I possess two females from the Amur which have a faint yellow tinge all over the white parts of the wings, as is sometimes seen in very fresh Alpine and Himalayan specimens. I think this fades very soon after the insect emerges from the chrysalis. Some specimens have two or three of the black spots on the fore wing pupilled with red, as in typical *P. delius*. The ocelli of the hind wing are sometimes with and sometimes without white pupils, but I have seen no specimen which cannot be at once recognized as *P. nomion*.

Of the habits and life-history of this species we know nothing at present; but it does not seem to be a high-mountain insect, but rather an inhabitant of wooded hilly regions, where it flies in July.

Schaufuss, in a publication called 'Numquam Otiosus,' published at Dresden in 1877, on pp. 417-424, after describing two varieties of *P. nomion* under the names of *venusi* and *virgo*, attempts to make an analytical table of the genus *Parnassius*; but this, depending alone on such variable characters as the colours and pattern of the wings, results in an unnatural and unreliable arrangement of the genus, in which no attention whatever is given to structural characters.

The publication of such papers is in my opinion of no advantage to science. As the number of recognized entomological journals is already too great, and the difficulty of reference to such a one as this almost insuperable to foreigners, one has at least a right to expect that after so much trouble as these references give, something worth notice should be found. Short papers of no value are becoming too numerous.

#### P. ACTIUS.

*Parnassius actius*, Eversmann, Bull. Mosc. 1843, iii. p. 540, t. ix. figs. 2 a, b; Staudinger, Stett. ent. Zeit. 1881, p. 278; Alpheraky, Lep. Kuldja, p. 23 (1881).

Var. *rhodius*, Honrath, Berl. ent. Zeit. 1882, p. 178, t. ii. fig. 6, 1885, p. 274.

This is a very puzzling species to assign to its proper position in the classification of the genus; for though it undoubtedly appears to have minor characters which entitle it to be recognized as a species in the high mountains of Northern and Eastern Turkestan, yet I cannot specify any by which it can be constantly distinguished from *P. discobolus*; and the form which has been described as *rhodius* is so like the corresponding sex of *P. jacquemonti*, that I am unable to distinguish between them in the male sex, and do not know for certain whether *P. actius* exists at all in Ladak or the Himalayas, whence no female corresponding to it with a keeled pouch has yet come under my notice. It is, however, distinct from the form I have called *himalayensis*, of which a large series constantly differs in the greater blackness of the antennæ, which, though ringed, are in many cases almost entirely black, whilst in *P. actius* from Turkestan, in *P. jacquemonti*, and *P. discobolus* they are, as far as my specimens go, always distinctly ringed with white. On the underside it perfectly agrees

with *P. discobolus*, *jacquemonti*, and *rhodius*, and differs from *himalayensis* in having the red markings much more strongly ringed with black. The pouch of the one fresh female I possess is quite like that of *P. delius*, small and much more covered with hair than in *P. apollo*, and the abdomen of this female is as hairy as that of the male, a character which seems very unusual in the genus.

The type, as figured by Eversmann, like those from the mountains of Khokand, is an insect with much fewer black scales on the wings than those from the Alatau, which are also less marked with red ocelli. The spot at the base of the hind wing above, a character which is principally relied on by Honrath to separate *P. rhodius*, is variable, as in other species of the genus, but does not appear in *P. discobolus*. In *P. himalayensis* it is often found, but more often is not visible on the upper side.

*P. actius* was discovered with *delphius* and *clarus* probably in the Tarbagatai (or, as Dr. Staudinger thinks, in the Alatau) by Schrenck, and remained almost unknown until a few years ago, when it was collected in some quantity by Haberhauer in the Alatau, near Lepsa. Later he also found it in the Sultan Hazret Mountains south-east of Samarkand, and in greater abundance on the northern slopes of the Alai Pamir, south of Osch, in Khokand.

Alpheraky also found it uncommon in the Thian Shan, at from 9000 to 13,000 feet elevation; and Grumm-Grshimailo found it near Katta-Karamuk, and at Karasu on the north side of the Tersagar Pass, which cross the Trans-alai Mountains of Karategin at an elevation of 10,000 feet. In the former place, which seems a wonderfully rich collecting-ground, *P. discobolus*, *mnemosyne*, and *romanovi* also occurred; in the latter *P. staudingeri*, *romanovi*, and another. This region seems to be more rich in species of *Parnassius* and *Colias* than any other in the world; for at Kizil-art, on the western Pamir, which the same energetic collector also visited, he obtained, along with *P. actius*, a new one, which he calls *P. cæsar*, a form of *P. delius*?, and another, thus obtaining no less than nine species of this genus in a single journey, besides six or seven of *Colias*, and many new and interesting *Lycænida*, *Erebia*, and others.

*P. ACTIUS*, var. *DISCOBOLUS*.

*Parnassius discobolus*, Stgr. Berl. ent. Zeit. 1882, p. 182, t. i. figs. 1-3.

*P. corybas*, var. *discobolus*, Alph. Lep. Kuldja, p. 16 (1881).

*P. (corybas)*, Fisch.?, var. ?) *discobolus minor*, Stgr. Stett. ent. Zeit. 1881, p. 275.

This form was first found in great numbers by Haberhauer in the Alatau, and later also very abundantly by Alpheraky in the Thian Shan range. Both Staudinger and Alpheraky in their descriptions go into many details of the markings, number of ocelli, and other peculiarities of this insect (which is extremely variable both in size and colour) in their endeavours to show that it is distinct from the somewhat mythical species *P. corybas*, Fischer; but neither of them gives any constant characters by which it may be separated from *P. actius* and

the Siberian form of *P. apollo* known as *hesebolus*. In fact Staudinger says he received some specimens which are intermediate between *discobolus* and *actius*, and may be hybrids of them in his opinion; while Alpheraky describes a form which he thinks is a hybrid between *hesebolus* and *discobolus*, and states in confirmation of this theory that he found a male of the former *in copula* with a female of the latter.

I confess that after careful examination of Dr. Staudinger's series, as well as of those I have received from him and M. Alpheraky, I can find no constant characters; for the absence of the red spot at base of hind wings is not constant, as Schilde, in Ent. Nachrichten, 1884, p. 334, observes; and even if it was in some species, it is certainly not in *discobolus* or *actius*. I see nothing in the pouch, fringe, or antennæ to make this form worthy of separation, though it is almost impossible, on the other hand, to say to what it should be joined, unless it is *P. actius*; and some of the American specimens of *P. smintheus* are also exceedingly close.

Alpheraky found it in all parts of the Thian Shan which he visited, at elevations of 3500 to 11,000 feet, from the 15th of May throughout the summer, the specimens found at high elevations being smaller, less richly coloured, and more like those of the Alatau Mountains, which Staudinger has separated as var. *minor*. What Staudinger describes as ab. ♀ *nigricans* seems, according to Alpheraky, to be a not uncommon form of the female at low elevations. It is simply a form in which the wings are very diaphanous and covered with black scales to such an extent that when on the wing they seem black.

The yellowish tint which very fresh specimens of *Parnassius* (especially females) often show is found in *discobolus*; and I noted in one specimen in Dr. Staudinger's collection that the fringes of the fore wings are blackish, whilst others had a very strong resemblance to *nomion*, but could apparently be certainly distinguished by the fringes of the hind wings, which are never so distinctly chequered as in that species.

#### P. ACTIUS, var. HIMALAYENSIS.

*Parnassius jacquemonti*, Blanch. Jacquemont's Voy. p. 16, t. i. figs. 3, 4; Moore, P. Z. S. 1882, p. 257; Oberthür, Et. Ent. liv. iv. 1879, p. 23, t. ii. fig. 5; Honrath, Berl. ent. Zeit. 1885, p. 274.

Though it is very difficult to say what this species may be, I think it certain that it is not the *P. jacquemonti* of Boisduval, on account of the remarkable difference in the pouch, which I have pointed out in alluding to that species. Neither Moore, Gray, Blanchard, Honrath, nor Oberthür seems, however, to have paid any attention to Boisduval's description of the pouch, or, if they did, failed to understand the importance of this character. The extreme rarity of female specimens of the true *P. jacquemonti* in museums has doubtless prevented other writers from distinguishing the form now under notice from the much rarer and more inaccessible species

which Jacquemont seems to have found on some part of the Kashmir territory.

The species now under notice might very fairly be said to be the Himalayan representative of *P. delius*; but though I cannot specify any structural character by which it differs from that species, yet it has far more general resemblance to *P. actius*. It differs from that species (which perhaps also occurs in Ladak) in the fringes of the wings, which in *P. actius* are almost always distinctly marked with black at the end of the nerves, and in the darker antennæ less ringed with white, and the ocelli of the underside, which are much less ringed with black.

I have received such a large number of specimens of this species from Lahoul, that I am able to say with some certainty that the pouch of the female is always keeled; and though there is, as I show below, very great variation in specimens from one locality, yet I think I could say that none of those from this one locality could be mistaken by one who really knew the species for any other *Parnassius*.

After examination of a large series from Lahoul, taken between July 15 and Aug. 28, 1884, at various elevations between 11,500 and 15,000 feet, I find the following principal variations:—

As regards the ground-colour of the wings, from a pure creamy white to a yellowish white, only seen in very fresh specimens and most pronounced in females; the black scales in some cases almost covering the interspaces of the wings and giving the insect a very dark appearance, whilst in some others, mostly males, they are almost confined to the costal and basal areas and to the line of the nerves. As a rule the females have a greater abundance of these black scales than the males.

As regards the fringes, I find in some specimens, usually those least marked with red, an almost unbroken white fringe, whilst in others it is more or less broken by black at the ends of the veins, but never so distinctly alternated with black and white as in *jacquemonti* or *actius*; and this is one of the best means of distinguishing the males from these species.

As regards the red ocelli, they vary in number from none to three on the fore wing above, of which two are near together between the cell and apex, and one about the middle of the space, between the third median nervule and the submedian nervule, and in size from a mere dot of a few red scales surrounded by black to an ocellus about 2 lines in diameter.

On the hind wing above they vary in number from two to six, of which one is at the base of the costa (usually, but not always, conspicuous, and sometimes quite absent), one halfway along the costa, and one extending from the second subcostal nervule to and beyond the discoidal nervule: these two are always present, and sometimes large and pupilled with white; one, and in females often two, at the anal angle, and rarely one showing through the black scales at the base of the cell.

On the underside the full number of red ocelli (namely three on

the fore wing and four on the hind wing), together with the four basal ones, are almost always present, corresponding to those on the upper surface, in which the red is often absent. The pattern of the underside is very characteristic, and would, I think, alone be enough to distinguish all the specimens from Lahoul from any other species.

The antennæ are decidedly blacker than in any of the allied forms, and though ringed faintly with whitish in some specimens, are never so much so as in all the forms of *P. delius*, or in *P. actius*, *discobolus*, and *jacquemonti*. They vary so little in 100 specimens that I have examined, that should series from other localities besides Lahoul be found to present the same constant differences in antennæ and markings from *P. actius* that these do, I think it might be allowed specific rank with as much or more justice as other so-called species of *Parnassius*. Of the habits we know but little. It begins to fly about the middle of July or earlier, according to the season and elevation, and continues to be found in a fresh condition till the end of August.

I think that the figures of Blanchard and that given by Oberthür, which is taken from a male specimen from Boisduval's collection, supposed by him to be the type of Boisduval's description, represent this species and not the true *P. jacquemonti*.

Whether this species ever occurs in the same region with that insect I am not at present able to say; but I think it does not occur at so high an elevation, and I doubt whether it extends to Ladak. I have never seen specimens from any locality east of the Ganges valley in Upper Gurwhal, where Mr. Duthie found it at elevations of about 11,000–13,000 feet near Phuladaru.

#### P. HONRATHI.

*Parnassius honrathi*, Stgr. Berl. ent. Zeit. xxvi. 1882, p. 161, t. i. figs. 4, 5, 5 a.

*P. corybas*, Ersch. Fedtschenko's Reise, p. 2, t. i. figs. 1, 2 (1874) (nec Fischer).

This little-known species seems to have been first discovered by Fedtschenko at Kulbasin, near Sangi Djuman, on May 25, and Kuli Kalan on June 25, in Zarafshan, about 7000 feet high, but being mistaken by Erschoff, who described the Lepidoptera of the collection, for *P. corybas* of Fischer, remained unknown until Habershauer sent from the Hazret Sultan Mountains south of Samarkand a number of specimens (about 20 males and 5 females), which he took at about 6000–7000 feet in July 1881. These were described by Dr. Staudinger, who considers the species quite distinct from *P. corybas* of Fischer, which comes from Kamschatka, and is probably only a form of *P. delius*.

It differs from all other *Parnassius* of this group in having black antennæ, black fringes, and black legs and feet; the clothing of the body beneath is also black.

The pouch of the female is of the *apollo* type, though this is not shown either in Erschoff's or Staudinger's plates; and Staudinger says that in one specimen it has a rather produced point.

I have seen Erschoff's type in the museum at St. Petersburg, and have little doubt that it is identical with Haberhauer's, of which I possess one example; but the fringes of the former are not so black and do not seem to be correctly represented in the figure.

In general appearance the species is extremely similar to *P. discobolus*, and, no doubt, varies in the usual manner.

Though I cannot find Fedtschenko's locality in a large-scale map of Turkestan, yet it cannot be very far from the mountains where Haberhauer found the species; and neither he nor other explorers seem to have met with it further north or east, whilst to the south and west are no mountains at all connected with this range<sup>1</sup>.

#### P. DAVIDIS.

*Parnassius davidis*, Oberthür, Et. Ent. liv. iv. p. 23, t. ii. fig. 2 (1880).

Beyond the single specimen which M. Oberthür has described, nothing is known of the species, which seems to differ in nothing from *P. nomion*, excepting that the fringes of the wing are entirely black. It has also, as M. Oberthür informs me, grey antennæ ringed with black, and the club black, the legs grey, with the last articulation only black. It was discovered by the distinguished naturalist, Abbé David, in the Jehol Mountains north of Pekin, and must be either very local or rare, as no other specimen was ever procured by him in his numerous journeys in the north of China.

#### P. BREMERI.

*Parnassius bremeri*, Feld. MSS.; Brem. Lep. Ost Sib. p. 6, t. i. figs. 3, 4 (1864); Feld. Reise Novara, i. p. 133, t. 21. e-g (1865).

Var. *græseri*, Honrath, Berl. ent. Zeit. 1885, p. 272, t. viii. figs. 1, 1 a, b, c.

This species, sent by Bremer to Felder as *P. delius*, is undoubtedly a good and distinct species, very variable in colour, but always to be recognized by its black antennæ, plain black-and-white-edged fringe, and black pouch of the *apollo* type; but like those of its countryman, *P. nomion*, the pouch is more prominent and less covered by hairs. The veins are always covered with black scales, as in the *mnemosyne* group. In the number and colour of the ocelli it is extremely variable, some specimens having no red markings on either wing; but the majority have three or four on the hind wing, and some have two, or even three, on the fore wing as well. Two fresh females from Khabarofka, one of which is without a pouch, have the fore wings (which are without any red) strongly tinged with yellow; but out of nine males and nine females in my collection, not one presents the slightest deviation from the characters of the species, excepting that the antennæ of some pale-coloured males from the Amur are faintly ringed with whitish.

<sup>1</sup> Since this was in print, I have received a specimen of *P. honrathi* from the Grand Duke Nicholas, collected by M. Grumm Grshimailo at Agwas Potasuk, which I believe to be in the mountains of Karategin.

This species was discovered by Radde in Amurland, where it seems common in many places from the middle of May till the beginning of July. Christoph discovered the larva on a slope above a swampy valley near Raddefskaia, but gives no details as to its food plant, or the habits of the insect. Its range extends from the Upper Amur to the Ussuri, but not apparently to the coast; and as far as I can learn, it is an inhabitant of mountains as well as of low-lying wooded districts.

The form described by Honrath as var. *graeseri* has red spots on the fore wing beyond the cell, which are rarely found in the typical *bremeri*; this form appears to be common, and is perhaps the prevalent one near Pochrofska in the Jablotschnoi Gora (Apfelgebirge) in Transbaikalia, near the watershed of the Amur region, at about 4500 feet elevation. Unless, however, it is proved to be constant and peculiar to this locality, I do not see any reason for separating it.

#### P. APOLLONIUS.

*Parnassius apollonius*, Eversm. Bull. Mosc. 1847, iii. p. 71, t. iii. figs. 1, 2; Alph. Lep. Kuldja, 1881, p. 20.

This distinct species was only known from Eversmann's description and figure in the Bulletin of the Moscow Academy for 1847, until quite recently, when it has been taken in large numbers by Alpheraky at Sibö, near Kuldja, and by Haberhauer in Ferghana. According to Alpheraky's account, it is an inhabitant of saline steppes about 2000 feet above sea-level, and flies at the end of March and beginning of April, laying its eggs on a species of *Salsola* which is abundant here, and which is probably the food-plant of the larva. Eversmann, however, says that it flies in the mountains of Soongaria in June; and Erschoff says that it was taken by Fedtschenko's expedition between 8000 and 12,000 feet in July. These statements appear almost irreconcilable (*cf.* Alpheraky, *l. c.* p. 21); and if the latter is correct, the vertical range of this species is greater than that of any other *Parnassius*. Grumm-Grshimailo found it near Woadjili, south of Osch, at the beginning of June, but gives no particulars of its habits, save that the locality is bare, rocky, and very hot; it is about 3000 feet above the sea, according to the Russian Staff-map of Turkestan. The same explorer found it afterwards near Karamuk, in the north-east corner of Karategin, at about 7500 feet. Alpheraky further states that whereas the fringe of the wings in Kuldja specimens is alternately white and black, it is, in those from Ferghana, almost entirely white; but in nine specimens in my collection, of which four are from Kuldja, four from Margilan, and one from Samarcand, I do not find this remark confirmed, as the fringes are more or less marked with black in all the examples. The antennæ of this species are deep black, the hairs of the neck, thorax, and abdomen white. The number and size of the red spots vary as in other species. The pouch is of the same form, but perhaps rather larger than in *P. apollo*, black in colour, and somewhat prominent as in *P. nomion*.

*P. ACCO*, Gray.

*Parnassius acco*, Gray, Cat. Lep. Brit. Mus. i. p. 76, t. 12. figs. 5, 6 (1852).

*P. acco*, Elwes, P. Z. S. 1882, p. 400.

Of this rare and very curious species we know hardly anything. It seems to be confined to the elevated desert regions of Ladak, and not more than six or seven specimens are known to exist in collections, viz. two in the British Museum (the types), two in Messrs. Godman and Salvin's collection, one in my own, which I owe to their kindness, and one, which I have also examined, in Baron Felder's. The two first of these were collected along with the types of *P. charltonius* and *P. simo* in Ladak many years ago by Major Charlton, at about 16,000 feet. The next three were taken by the late Mr. Shaw on his journey to Yarkand, at Lapsang, south of the Karakoram pass, about 17,000 feet above the sea, and were given by him to Mr. Bates, whose collection of Lepidoptera passed into Messrs. Godman and Salvin's hands. The last was taken by the late Dr. Stoliczka on the Samanda pass, 17,000 feet, near Lake Tsomoriri in Ladak.

I have also a single small specimen, which came, along with *P. sikkimensis*, from the Tibetan frontier, north of Sikkim, and which I cannot separate from *P. acco*, though in size and colour it is more like *P. simo*, and led me at first to consider those two species as one when I first received it.

They all agree very well in the important characters, having black antennæ and whitish fringes; but the most remarkable character is the pouch, which in this species develops a keel of such extraordinary depth, that when sitting on level ground the abdomen of the insect must be elevated at a considerable angle. This remarkable pouch is similar in two perfect specimens, the one figured (Plate II. fig. 3) being from Mr. Godman's collection.

A more minute examination of them shows that the fringes of the wings of *P. simo* are very different, and though neither the British Museum nor Hewitson's specimen has the pouch in a perfect condition, yet I have little doubt that the pouch of *P. simo* will be also found to be different from that of *P. acco*.

Since 1881 I have had several collections from the same part of Tibet, and obtained a few more specimens of *P. sikkimensis*, but this single one of *P. acco* remains unique from that region, and none of the numerous collections made at Darjiling, which sometimes contain specimens from high elevations, have, as far as I know, ever included any *Parnassius* except *P. hardwickei*.

*P. SIMO*.

*Parnassius simo*, Gray, Cat. Lep. Brit. Mus. p. 76, t. 12. figs. 3, 4.

Of this species almost nothing is known; there exist in all museums, to my knowledge, but four specimens—two in the British Museum, collected by Major Charlton in Ladak, and two others, of which one is in the Hewitson and one in M. Oberthür's collection, and both

from their flattened appearance and age seem to have come from the same source.

I have been able to find out the route which Major Charlton followed in Ladak, or Chinese Tartary as it was called in those days, and among the few scientific travellers who have been to that remote and inhospitable region, none seem to have again found this curious little insect. It may, however, be distinguished from *P. acco* and *P. sikkimensis* by the fringes of the wings, which are black in the fore wing and greyish white in the hind, whilst in *P. acco* they are all whitish. The antennæ are black, the pouch is unknown; and the position of the species in the genus must therefore remain doubtful, though I should imagine that it will be found nearly allied to *P. acco*.

*P. JACQUEMONTI.*

*Parnassius jacquemonti*, Boisduval, Sp. Gen. p. 400 (1836) (in part).

? *P. jacquemonti*, Gray, Cat. Lep. Brit. Mus. p. 76, t. xii. figs. 1, 2 (1852), ♂.

? *P. jacquemonti*, Moore, P. Z. S. 1865, p. 488.

*P. epaphus*, Oberthür, Et. Ent. liv. iv. p. 23 (1879).

? *P. actius*, var. *rhodius*, Honrath, Berl. ent. Zeit. 1882, p. 178, t. ii. fig. 6, ♂.

*P. epaphus*, var. *sikkimensis*, Elwes, P. Z. S. 1882, p. 399, t. xxv. figs. 4, 5, 6, ♀.

The synonymy of this species is the only one which has given me any trouble to clear up, and this arises principally from the fact that Boisduval probably used examples of two species in writing his description, and that his female type is not now to be found either in the Paris Museum, where the other specimens collected by Jacquemont which Boisduval described are preserved, or in his own collection, now in the possession of M. Oberthür. The point on which the whole question turns, is the fact that Boisduval says in describing the male that the fringes are entirely white, which is not the case in this species; and of the female he says that it is like the male, "La poche de l'extrémité de l'abdomen assez développée, plissée en travers et sans carène longitudinale." As no other species is known to exist in which a pouch of the *apollo* type is without a keel, this fixes Boisduval's female with certainty; and though the name *jacquemonti* might perhaps be applied to the species of which he described the male—my *actius*, var. *himalayensis*—using Oberthür's name of *epaphus* for the species now in question, yet, as Oberthür's name was applied to Gray's insect of which he had only seen a plate, of which he did not know the female, and which, after having seen the specimens figured by Gray, I cannot distinguish from *actius*, I think it is more correct to apply Boisduval's name to a species of which there can be no possible doubt he described one sex. With regard to the insect described by Honrath, from specimens collected by Stoliczka, as *actius*, var. *rhodius*, I cannot distinguish the male sex from that of *P. jacquemonti*. Charlton's specimens figured by Gray may be one or the

other, and the same may be said of those which I possess from Tibet, collected by Lang, and from Murgli, Ladak, 17,000 feet, both of which are males, like those in the British Museum. I have, in fact, of this species only one doubtful female, which was taken near the Shigri glacier in Lahoul, at 13,000 feet, on August 25, 1884, the abdomen of which is too much damaged for determination; a single pair from Ladak lent me from the Indian Museum, Calcutta; and three pairs of the small variety *sikkimensis*, which I received through native collectors from the Chumbi valley on the Tibetan frontier of Sikkim, and which agree absolutely with the Shigri specimen in fringes and antennæ. All the females from the Sikkim locality, of which I have received several, agree perfectly in the pouch of the female, which is without a keel, like the one figured here (Plate II. fig. 1), and seem to differ only in being of a smaller size than those from Tibet, Ladak, and the north-west.

I cannot hear of any variation in the pouch of *P. actius*, which is keeled and indistinguishable in form from that of *P. discobolus*; and am certain that the female of the species figured by Oberthür as Boisduval's type also has a keel, so that the following points seem clear:—

1st, that Boisduval confounded two species in his description, of which one (my *actius*, var. *himalayensis*) has a keeled pouch, and the other, *jaquemonti verus*, has not.

2nd, that *actius*, var. *rhodius*, of Honrath, = *epaphus*, Oberthür, may be either *P. actius* or *P. jacquemonti*, as no reference to the female is made by either author, and the figures of the male cannot be distinguished from *P. jacquemonti*.

The habits of the insect are little known, but the notes of Capt. Lang quoted by Moore may be applicable to the true *P. jacquemonti*. He says, *P. Z. S.* 1865, p. 488:—"It replaces *P. hardwickei* on the high passes of Upper Kunawur, Spiti, and Tibet. I first saw it on the Kongma pass, leading from Kunawur into the Chinese province of Gughe in Tibet, at an altitude of 18,000 feet. This pass is 16,000 feet, but I ascended its flank another 2000 feet to enjoy the far view over the distant Tibetan ranges, brown and treeless, closed to European foot, and backward among the sharp icy pinnacles of our own more familiar Himalayan ranges; and here I saw this *Parnassius* coursing rapidly up and down the frozen snow-beds, where beaches as it were of boulders and stones cropped out. What could tempt *Parnassius* there I know not, for I saw not a *Sedum*, nor a *Saxifraga*, nor any other vegetation. I met this *Parnassius* again at high elevations, in similar situations along the confines of Kunawur and Tibet. It does not occur apparently with the next" (*P. hardwickei*).

In Sikkim it also occurs at great elevations and flies in August and September. I took myself, on the 20th September, 1870, a pair of this species *in copulâ*, on an unnamed pass above 18,000 feet elevation, by which I crossed from the Upper Lachong valley in Sikkim to the Cholamoo lake in Tibet. These specimens were given to the late Mr. Atkinson, and now stand in the Hewitson Collection as *P. simo*, along with one genuine example of that very distinct species from Ladak.

In describing the Sikkim form of this species (P. Z. S. 1882, p. 399) I said that it might be distinguished by the smaller size, and by the more distinct alternation of the black and white in the fringes. I am still unable to compare these with a series from Ladak, as no specimens except the few I have mentioned exist to my knowledge in collections; but the smaller size seems to me now not a sufficient distinction, and the spotting of the fringes is almost, if not quite, as marked in the specimen from Shigri. The name *sikkimensis* had better therefore be dropped until a constant and more marked distinction than that of size is shown to exist.

P. HARDWICKII.

*Parnassius hardwicki*, Gray, Lep. Nepal, t. 4 (1846); Cat. Lep. Brit. Mus. p. 76, t. 12. figs. 8-11 (1852); Moore, P. Z. S. 1865, p. 488.

Var. *charino*, Gray, l. c. t. 12. fig. 12.

*P. jacquemonti*, Koll. (nec Boisduval), Hügel's Kashm. p. 407, t. 2. figs. 3, 4.

This distinct and pretty species occurs at very various elevations, in most parts of the North-west Himalaya from Kashmir to Sikkim, at elevations varying from 6000 to 12,000 feet and probably higher, but in the north-west it occurs at much lower elevations than in Sikkim. It seems to fly at almost all times of the year in various localities, and varies very much in coloration, and especially in the number of the red and blue ocelli, at almost all the places where it is found. The five bluish ocelli on the hind wing, generally pupilled with white, but in some cases reduced to mere specks, are, however, present in all the specimens I have seen; and as a rule the greater the amount of black scales, which in some female specimens almost cover the wings, whilst in others of the male sex they are entirely wanting, the larger and more numerous are the red ocelli.

The variety *charino*, Gray, is the darkest form, but does not seem to be either a local or a seasonal variety, as I have it from Simla, taken in May, from Gulmurg in Kashmir in August, and from the Chumbi valley in September.

The red spot at the base of the hind wing above is more or less well marked in four out of twelve females in my collection, and convinces me that it cannot be looked on as a specific character in this genus.

Of the life-history of this species we know something, and, strange as it may seem to European naturalists, I have little doubt that the species is double-brooded. Capt. Lang (P. Z. S. 1865, p. 488), says, "There appear to be two broods, early spring and late autumn. I have seen it in December and February on bright days, succeeding weeks of snow storms." Hocking took 16 specimens, of which one was a female, flying over snow in March, at 8000 feet elevation.

Capt. Graham Young, writing from Kulu, says:—"Undoubtedly *P. hardwicki* is double-brooded; the second brood appears in August and September, and a few even in October in favourable seasons; some of these hibernate, reappearing in March along with the spring

brood, which has hybernated in the pupa: of this fact I have no manner of doubt." In another letter he says, "When coming over the Rhotang pass about October 10, 1874, I saw numbers of the larvæ of *P. hardwickei* on the low herbage, and have no doubt myself but that some of this species hybernate as butterflies, but by far the greater number in the pupa; that this insect is double-brooded no one who knows its habits disputes; the larva feeds on various species of Saxifrage." In another letter Capt. Young says, "In the outer Himalaya (I speak of Kulu only) *P. hardwickei* does not vary; but in the interior it varies from typical *hardwickei*, through light and dark grey, to the high-level form *charino*."

Capt. Lang says, in P. Z. S. 1865, p. 488, that this species in Kunawur commences at the Runang pass, becoming commoner as we travel south and west towards Lower Kunawur and Simla, not extending nearer the plains than Simla, however. It is tolerably abundant on the Mahasoo ridge, near Simla, on bare grassy hilltops, just clear of oak-woods; grassy open downs it certainly affects, and at high elevation, 8000 feet. It has a strong but slow flight, somewhat like that of *Pieris*, keeping low over the rocks which crop up amongst the grass."

The form of the pouch in this species separates it widely from any other of the genus (see Plate II. fig. 5). The fringes of the wings are white and long, the antennæ black.

#### P. DELPHIUS.

*Parnassius delphius*, Evers. Bull. Mosc. 1843, iii. p. 540, t. 7. fig. 1 a, b.

Var. *namagana*, Stgr. MSS.

*P. staudingeri*, Haas, Berl. ent. Zeit. 1882, p. 163, t. 11. figs. 7, 8, 8 a.

Var. *infernalis*, Stgr. MSS.

I think there can be little doubt that *P. delphius* and *P. staudingeri* are one species, and time will show whether the Himalayan ally, *P. stoliczkanus*, can be separated from them; but from whatever point of view they are regarded, these three form a very natural group, differing widely from all other species in the form of the pouch, which, though it has some analogy with that of *P. hardwickii* in being divided into two lobes, is, as the plate shows, quite unique in form.

*P. delphius* was first described from the Tarbagatai range by Eversmann with *P. clarius* and *P. actius*; and it should be noted that though he says these species came from the southern slopes of the Altai Mountains, yet Kindermann, who collected in the true Altai Mountains, is quoted by Lederer in Zool.-Bot. Ver. Wien, 1853, p. 353, as follows:—"It will perhaps be wondered that I did not find in the district I explored (which lies on the upper Irtisch between Ust Kamenogorsk and Ust-buchtarminsk) the species described by Eversmann in the Moscow Bulletin as from the Altai. These, however, do not inhabit the Altai, but are only indigenous 700-1000 versts to the south, and were collected by Herr Schrenck,

a botanist of St. Petersburg, in the Tarbagatai and *Allakan* Mountains."<sup>1</sup> It has since been taken abundantly by Alpheraky in the Thian Shan Mountains, above 9000 feet elevation, in July and August. It frequents steep stony mountains up to 12,000 feet, where there are great abundance of Saxifrages. Haberhauer also took it in the Alatau, and in the Sultan Hazret mountains, south of Samarkand, which form the western termination of the Alatau, in great quantity between the 10th June and the beginning of August.

This last was described by Herr Bang-Haas as *P. staudingeri*, but after having seen large numbers of the two forms, three pairs of each of which are in my collection, I fail to find any difference by which they may be distinguished. Both are very variable, but both have the antennæ, fringes of the wing, pouch of the female, and all important characters absolutely identical.

Bang-Haas relies principally on the supposed broader fore wings, and the purer yellowish white ground-colour with much sharper blacker markings; but when he wrote he had not yet received the specimens of *P. delphius*, collected in Ferghana by Haberhauer, which vary extremely. Some of these (? var. *namagana*) have blue ocelli on the hind wing, as in *stoliczkanus*. Some of the females of *P. staudingeri* (var. *infernalis*, Stgr.) are very dark, almost black in their ground colour.

The antennæ in this species are in the male sex black, but in all my six females the lower part is more or less grey, not distinctly ringed. The fringes are very narrow, whitish in colour, but sometimes darker; and, as Bang-Haas points out, the horny substance of the pouch forms a complete ring round the hinder segment of the body.

Dr. Staudinger says it varies from a uniform grey colour with feebly marked blackish spots to a very dark colour with reddish-yellow, red, or yellow ocelli on the hind wings, and in one specimen two small red spots on the costal margin. The bluish scales of the two black round ocelli on the hind wing also seem to be often wanting in the freshest specimens. I noted in his collection a very curious looking organ protruding from the abdomen of a male specimen of *P. staudingeri*, which, having some analogy in shape to the pouch of the female, led Dr. Staudinger to think it was a hermaphrodite. This organ, however, which, owing to his kind loan of the specimen, I am able to figure (Plate II. fig. 14), is I believe only the ordinary male claspers protruded from the body, perhaps owing to forcible separation from the female.

#### P. STOLICZKANUS.

*Parnassius stoliczkanus*, Feld. Reise Novara, Lep. ii. p. 138 (1865), iii. t. 67. figs. 2, 3 (1867).

With regard to *P. stoliczkanus* we know but little, as it is an inhabitant of remote and inaccessible districts in Ladak and the northern frontier of the North-west Himalaya. The late Dr. Stoliczka

<sup>1</sup> Perhaps this is a misprint for Alatau, as I can find no such name in the best modern maps.

took a single pair at Narka, in the province of Rupshu, which were described and figured by Felder. Two females in the Hewitson collection are marked Darjeeling, but there is no evidence that they came from Sikkin; and though both have larger red ocelli on the hind wing than the Ladak specimens I have seen, yet they are probably from Atkinson's collection, which was made at many places in the Himalaya as well as at Darjeeling. M. L. de Nicéville, who is the only living entomologist who has seen this species alive, took three specimens (of which a pair are now before me) on July 18, 1879, on the Baralacha pass, north of Lahoul, at 18,000 feet. Both of these have small ocelli on the margin of the hind wing, three of which in the ♀, and one in the ♂ have bluish pupils. The male has no red markings at all, whilst the ♀ has two ocelli in the usual place on the hind wing; none that I have seen have the red ocellus on the costal margin of hind wing, which is found in all specimens of *P. delphius* and *P. staudingeri*. The fringes and antennæ, however, agree perfectly with those of *P. delphius*, excepting that the antennæ of the ♀ *P. stoliczkanus* are all black; and though I hardly consider that the few specimens of this species existing show any structural characters of sufficient importance to separate them certainly from *P. delphius*, yet the absence of the costal ocellus on the hind wing would if constant be a good secondary character of distinction; and there appears to be some difference in the internal structure of the pouch, though its external appearance is nearly the same as that of *P. delphius*.

In a very interesting account of his journey through the Alai Mountains in the southern part of Khokand, M. Grumm Grshimailo describes a new species of *Parnassius* shortly, under the name of *P. romanovi*, which, though I have not yet been able to see a specimen, is possibly a form of this, but more probably allied to *P. charltonius*. He says:—"The fore wings like *delphius*, the hind wings show a great red patch of 1 centimetre in diameter, a second of much smaller dimensions, and a band which is formed of three red marks; behind this red band, nearer the outer margin, are five beautiful blue ocelli surrounded by black shining scales."

This splendid insect was found near Katta-Karamuk, and also at Karasu, on the north side of the Tersagar pass, 10,000 feet, in company with *P. actius*, *P. staudingeri*, var. nova, *Parnassius* sp., and many splendid species of *Colias* and other insects.

Another new form, named, but not described, by the same explorer, is *Parnassius cæsar*, which was found at Kizil Art, on the Alai Pamir plateau, at a great elevation, and said to be a splendid, quite unique species of great variability, and will no doubt be soon published in the Grand Duke Nicholas's 'Mémoires sur les Lépidoptères,' which have already added so much to our knowledge of Russian Lepidoptera.

It will be impossible to say where these species belong in the genus, until they are fully described and figured<sup>1</sup>.

<sup>1</sup> After this paper was read I received, through the kindness of the Grand Duke Nicholas Mikhailovitch of Russia, two pairs of *P. romanovi*, which is

**P. TENEDIUS.**

*Parnassius tenedius*, Eversm. Bull. Mosc. 1851, ii. p. 631; Mén. in Schrenk's Amurl. vol. ii. Lep. p. 14, t. 1. fig. 3, ♀.

Of this remarkable species but little is known, though it has a wide range in Eastern Asia, and has been collected recently in some numbers by Herr Tancré's collector in some parts of the southern Altai Mountains, in April and May. Eversmann received it first from Irkutsk. I have a female specimen collected by Puzilo at Albasin on the Zeya river in upper Amurland. Ménétries describes and figures a female from Olekminsk on the Lena river. I have seen specimens in the St. Petersburg Museum, collected by Czernakowsky on July 14, 1873, on the lower Tunguska. Major von Hedemann also collected this species at the Schilka, in the upper Amur region, in May.

*P. tenedius* has a pouch-like appendage unlike that of any other of the genus, though it has some analogy to that of *P. imperator*. It is very delicate and wax-like in substance, open at the bottom and difficult to examine, but the figure I have given will explain its structure better than words. In a female collected by Maack, which I saw in the St. Petersburg Museum, the pouch is not developed, but eggs of apparently full size are visible inside the abdomen, and I possess another in which it is only partially developed; but the two perfect females in my collection, together with at least five others which I have examined, all agree in the general form and substance of this curious appendage. See Plate II. fig. 9.

The antennæ are black, the fringes of the wings show a narrow black line distinctly edged with white. The hairy covering of the body is less abundant in the males of this species than in most other *Parnassius*; the number and size of the red markings vary just as in other species, but those from Amurland appear generally to have them most abundantly.

Nothing is published as to the habits of this species, which is very scarce in collections at present.

**P. IMPERATOR.**

*Parnassius imperator*, Oberthür, Bull. Soc. Ent. France, 1883, p. 79; Et. Ent. ix. p. 11, t. 1. fig. 4, ♀.

This splendid species at first sight presents the most remarkable resemblance to *P. charltonius*, but as soon as one examines the abdominal appendage, which in this case cannot be called a pouch, it is evident that a more different and peculiar structure cannot exist. I must refer my readers to the drawing (Plate III. fig. 4), as a description alone would give no true idea of its form, which, though in

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evidently very nearly allied to *P. discobolus*, and indeed hardly separable from it. These specimens do not agree with the description above given, which makes me think that the name has probably been transferred from the original insect described above to what is now sent as *P. romanovi*. I have to thank the Grand Duke also for a pair of *P. muzaffir*, Gr. Grsh., which also appears to be a form of *P. actius*, and Herr Christoph informs me that *P. charltonius* was also included in M. Grumm Grshimailo's collection from the same region.

some degree analogous to that of *P. teneidius*, is utterly unlike that of any known *Parnassius*. It is very curious that though M. Oberthür has received many examples of the female, he has as yet no male, as it will be most interesting to examine the clasping organs, in order to see whether they differ from those of *P. charltonius*, which I have figured, in as marked a manner as the female appendage does; M. Oberthür, who figures this organ well, says that he has two virgin females in which it is not developed.

There is some variation in the number of the large blue ocelli on the hind wing of this grand insect; normally they are two in number, but one specimen figured by M. Oberthür has two additional small ones above, which gives it even a stronger resemblance to *P. charltonius*, in which five is the usual number. The antennæ are black, the fringes of the fore wings black, edged with white, and of the hind wings plain white.

This grand species was discovered by the French missionary bishop of Tibet, M. Félix Biet, at Ta-tzien-lo, a town near the frontiers of China and Tibet, at about 7500 feet elevation, where it flies all the summer, and may probably extend throughout that very inaccessible tract of mountains which have yielded so many zoological and botanical treasures to the researches of Abbé David, and from whence so many new butterflies have recently been described by M. Charles Oberthür.

#### P. CHARLTONIUS.

*Parnassius charltonius*, Gray, Cat. Lep. Brit. Mus. p. 77, t. xii. fig. 7, ♂ (1852); Moore, Yarkand Mission, Lep. p. 5, t. 1. fig. 3, ♀.

This splendid species must be considered, with *P. imperator*, as the grandest of the whole genus. The superficial resemblance which it bears to *P. imperator* first led me to study the question of the pouches in this genus, which have been so much neglected, and which in this species is so remarkable.

First discovered by Major Charlton at Lapsang, in his journey in Ladak, so memorable in the history of the genus, and figured by Gray, along with *P. acco*, *simo*, *jacquemonti*, and *hardwickei*, *P. charltonius* remains one of the rarest and least known of the genus. Dr. Stoliczka found it again at Kharbu, 13,000 feet, in the same province, and the same naturalist during the Yarkand expedition obtained a female.

M. Lionel de Nicéville and Capt. Young have both found it at Koksir, below the Baralacha pass, in the province of Lahoul, from 12,000 to 14,000 feet elevation, where in some seasons it is not uncommon from the middle of July to the middle of August, when the females are still fresh.

Having had the whole of the specimens collected by these gentlemen under comparison, I find that, in this locality at least, they vary less than most species. None have any red in the usual spots on the fore wing, but on the hind wing is a small red ocellus ringed with black, and sometimes nearly obsolete, near the costa; a large

central ocellus usually with white pupil, and in the female sex a red oblong patch at the anal angle. Near the outer margin is a series of five large bluish-grey ocelli, broadly edged with black on the outside.

The fringe of the wings is white, broader and more distinct on the hind wings than on the fore, but never spotted; the antennæ are shining black; the thorax and abdomen in the male are black, thickly covered with short downy hairs on the thorax, and with longer paler ones on the abdomen, which extend over the base of the fore wing and the inner margin of the hind wings, as far as the anal angle.

The abdomen of the female is black with a few pale hairs down the centre of the upper surface, and divided into eight segments by distinct rings of a greyish colour; the terminal segment in the female is furnished with a tuft of short grey hairs, which, when the pouch becomes developed, turn up almost at right angles to the body. The pouch is a remarkably shaped one, different from that of any other species of *Parnassius* (see Plate III. fig. 5).

#### P. MNEMOSYNE.

*Parnassius mnemosyne*, Linn. S. N. x. p. 465.

Var. *nubilosus*, Christoph, Hor. Ent. Ross. x. p. 19 (1873).

This is the type of a large and widely distributed section of the genus. Some form of the group is found in almost every region where *Parnassius* occurs, and *P. mnemosyne* itself is of very wide distribution in Europe and Western Asia, but replaced in Eastern Asia and N.W. America by allied forms differing from it in minor characters, but preserving a very strong general resemblance in all important ones.

It is found in the Pyrenees at Cauterets (Oberthür), in thousands on meadows on the Spanish slopes near Gavarnie, at 6600 feet (Pierret *vide* Speyer), in the Neapolitan and Sicilian mountains, in Auvergne (Sand), in many parts of the French, Swiss, Styrian, and Italian Alps, from about 2300 to 5000 feet; but apparently of very local distribution, as Meyer-Dur had never seen it himself, and Dr. Staudinger told me that he had been equally unfortunate, whilst I have taken it abundantly in three different places. In many parts of N.E. Prussia, in Bavaria, the Hartz, in many parts of Austria, it is more or less common, and often at quite low elevations. I have taken it at Mödling, close to Vienna, on a low rocky hill among bushes. In the south of Russia, and in the north of Europe, it seems to be an insect of the steppes and forests rather than of the mountains. It occurs locally in Denmark, Scandinavia, Finland, and as far north as Archangel. In Asia Minor and the Caucasus, it is in many places abundant, and according to Lederer always at a considerable elevation up to 8000 feet, developing a smaller darker variety (*nubilosus*, Christoph) in Armenia and North Persia. In Asia it is found in the mountains of N. Persia, in various parts of Turkestan, and as far south as the Alai Mountains of Khokand, but not apparently in the Thian Shan or Altai, where it is replaced by *P. clarius*.

As far as I have personally observed, it is found in meadows where vegetation is rather rank; and at Berisal, on the Simplon pass, where it is most abundant at 4500 feet, the meadows where it flies have a north aspect, while *P. apollo* confines itself to the hot slopes on the other side of the ravine.

With regard to its life-history little is known. Meyer-Dür says that Kindermann discovered the *apollo*-like larva in April and beginning of May on *Corydalis halleri*, and that it pupates under fallen leaves in a strong web, the pupa being yellowish and like that of the *Zygænidæ*. I have made several endeavours to discover the larva myself without success, but I have strong doubts that *Corydalis* is the only, if even it is the usual food-plant, for this reason, that it is a spring flowering plant of very short duration; whilst *P. mnemosyne* must be an autumn-feeding larva, as the insect flies in spring or early summer very soon after the melting of the snow, and there could be no time for the larvæ to feed up after it melted.

From observations made in Wallis, in June 1884, and again in May 1885, I believe that the larva more probably feeds on an umbelliferous plant (? *Heracleum*, sp.), which was very abundant in the places where the insect was numerous, and on which the females often sat, whilst *Corydalis* was either absent or withered at the same date. Herr Bang-Haas thinks that in Denmark the larva is a night-feeder, but knows nothing certainly about it. I was very anxious to investigate the development of the pouch in this species as well as in *P. apollo*, and with this object visited Wallis in May 1885. On May 24, I found the males abundant at about 3000 feet on the south side of the valley, near Brieg, and caught several males and fresh females, all of which had the pouch perfect. In the previous year I found, a month later, at Berisal, that the males were worn, and the females, though they were in two or three cases taken *in copula*, had apparently been flying for some time, and had a perfect pouch. After a good deal of searching I found a female fresh from the pupa, at about 11 A.M., sitting on an umbelliferous plant, either *Æthusa* or *Heracleum*. I took her home and put her in a birdcage covered with gauze at about 2 P.M., and at 2.30 one of the males which had been fluttering round her for some time commenced copulation. The female held on to a grass stem with the head upwards and the male hung to her with head down. At 2.45 the female crawled up to the top of the cage, carrying the male with her; he made no attempts to use his feet or hold on, and was supported entirely by the abdomen. At intervals of a few minutes there were slight movements of the abdomen of the male, but otherwise he remained quite torpid till about 4 P.M., when the pair suddenly separated without any appearance of a pouch on the female, whose abdomen remained large and swollen as at first. At 6 P.M. there was not the least change in her appearance; she remained quietly holding on to the gauze, whilst the male crawled about the cage. In the evening I put another fresh caught male in, and on the following morning put the cage in the hot sunshine at 7.30 A.M. All three insects fluttered and crawled about the cage for some time, but showed no

inclination to come together. I watched the cage till 3 P.M., when the insects appeared as before, but the males much less active. On the following morning I found one of them dead, and after waiting for some hours to see if anything would happen, went out. When I returned I found the female had escaped, some one having probably opened the gauze from curiosity. Several eggs were lying loose at the bottom of the cage, but these were lost in travelling. From these experiments I can form no conclusion as to whether the copulation had been incomplete, owing to the male having previously mated with another female, or whether the duration of the act was insufficient; but the fact remains that eggs were laid by a female without a pouch, and that three days after emergence from the pupa, she remained healthy, though no pouch was formed. It seems to me that on account of the larger size of the pouch in this species it would be a better one for anatomical observation than that of *P. apollo*; and I hope that any entomologist who can assist me in making further investigations by supplying me with larvæ or pupæ of this species will do so. As to whether the pouch is ever shed by this or other species of *Parnassius*, as asserted by some observers, I can only say that I never saw one without it, except specimens which from their extreme freshness I suppose to be unmated females, and of these I have numerous specimens belonging to 8 or 10 species.

One fact seems hard to explain, and that is the copulation of specimens which, from their appearance, were evidently not freshly hatched, which I have noticed both in *mnemosyne* and in *delius*, but which always separated when caught. Is it the case that, contrary to the usual rule, the male only mates once and dies afterwards, whilst the female, after having laid, is still attractive to males which have not found a mate previously? If Mr. Watson's observations on *P. apollo* are correct, and the pouch is formed by a secretion exuded from the male and not the female, this seems likely; connection of the pouch with the abdomen in all species of the *mnemosyne* group seems to be only at the hinder end, as at the forward end it is often quite separate from the body, and the edges more or less recurved.

The variation of markings and size in this species is slight. Some specimens show a tendency to transition into *P. stubbendorfi* by the partial disappearance of the discal black blotches, and some females are almost devoid of the milky white scales which cover the greater part of the wings, but unless the var. *nubilosus*, of which I have seen but few, is a constant variety, I know of none which are worthy of especial notice, though Honrath describes a female melanic aberration from Carinthia as *melania*.

#### P. STUBBENDORFI.

*Parnassius stubbendorfi*, Mén. Desc. Ins. Lehm. p. 57, t. vi. fig. 2 (1848).

*P. mnemosyne*, var. *immaculata*, Mén. Bull. de la classe [phys.-math. de l'Acad. vol. v. n. 17.

*P. stubbendorfi* ab ♀ *melanophia*, Honrath, Berl. ent. Zeit. 1885, p. 274.

This species appears to have been first discovered by Lehmann near Kansk in Central Siberia, and has since been found in Dahuria by Radde, and in many parts of the Amur region down to the coast by Christoph, Graeser, and others, where it appears to be abundant in many places, and flies from the 19th of May to the end of June or later. On the island of Askold it is not rare, four males in my collection from this place being larger than those from the Amur, and showing traces of the black patches on the cell of fore wing, which are conspicuous in *mnemosyne*. In Corea a form occurs which seems intermediate between this species and *P. glacialis*, but has not the yellow body of the latter; and though I have seen no specimens from the western limit of its distribution, I should expect to find a similar transition to *P. mnemosyne*. Graeser, however, in Verh. Ver. Hamburg, 1879, p. 201, says that when all the specimens sent by Consul Lühldorf and Dorries from various parts of the Amur are compared, he doubts the distinctness of this species from *P. mnemosyne*, as they show great variation in the amount and distinctness of the black markings, which sometimes are so distinct as to form a complete transition to *P. mnemosyne*.

The pouch of the female is similar to that of the last-named species, and in five females in my collection varies only in length, and is sometimes more produced behind than is usual in *P. mnemosyne* and generally darker in colour.

#### P. GLACIALIS.

*Parnassius glacialis*, Butler, Journ. Linn. Soc., Zool. ix. p. 50 (1866).

? *P. citrinarius*, Motsch. Bull. Mosc. 1866, i. p. 189.

This form, which appears to be found locally in some of the higher mountains of Japan, is undoubtedly very nearly allied to *P. stubbendorfi*. It differs from that species in its larger size and in the well-marked yellow hairs of the neck and breast, which in *P. stubbendorfi* and *mnemosyne* are found in the female only. The ground colour of the males is also of a much yellower tint than in *P. stubbendorfi*. The two females in my collection, which are all that I have seen, have a blackish pouch resembling that of *P. clodius* in being considerably shorter than the pouch of *P. mnemosyne* or *stubbendorfi*.

Mr. Pryer says of this species, in his Catalogue of the Lepidoptera of Japan:—"I have taken this abundantly at Nikko in June and July, and received many from Yesso. It varies considerably in size, colour, and markings. I have eleven specimens in my cabinet, no two of which are exactly alike. Yesso specimens are generally whiter than those from Nikko, from whence I have a specimen almost black. Some are without the dark patch on disk of fore wing, others have one and two patches, and a dark band on the outer margin of the fore wing, which sometimes extends to the hind wing. The female has sometimes a peculiar horny sheath attached to the underside of the abdomen." Mr. Strecker says he has re-

ceived *P. glacialis* from Corea, but some from that country in Mr. Godman's collection are more like *P. stubbendorfi*, which is also found in the island of Askold.

There is little or no doubt that Motschulsky's name of *citrinarius* was applied to this species, and would certainly be preferable to Butler's, which is without signification, there being nothing whatever glacial in the habitat of the insect. As, however, the priority of publication is doubtful, and Butler's name is in common use, it may be retained for the sake of convenience.

The law of priority is no doubt an excellent one, but may be carried too far, and in all cases where the type of an insect is unknown, or where, as is so often the case, in old descriptions, or in variable species, it is impossible to fix it with certainty to a known and sufficiently defined form, it is better to ignore it than to run the risk of confusion by altering the accepted name. I must say, however, that many of the names applied to Lepidoptera by some modern authors, among whom Messrs. Butler and Moore are conspicuous, seem to be most faulty. A specific name should, I think, always be given with regard either to some peculiarity of size, colour, form, or structure of the species, or should give some clue either to the locality, or to a person in some way connected with the insect. If, however, nonsensical or barbarous names such as *nicconicolens*, Butler, *rabdia*, Butler, *rikuchina*, Butler, or misleading names such as *glacialis* in this case, or *Terias hybrida*, Butl., or names derived from Hindoo mythology, often incorrect, as *Sabbaria peeroza*, Moore = *Papilio polyctor*, and numerous others of the same character, then it becomes much more difficult to remember the name at all, and to remember to which species it belong. And I have personally found this difficulty to be much greater among the Lepidoptera than it is among birds or plants, which are, as a rule, much more rationally and sensibly named than butterflies.

P. EVERSMANNI.

*Parnassius eversmanni*, Mén. Enum. part 1, p. 73, t. 1. fig. 2 ♂ (1855); W. H. Edwards, Butt. N. A. p. 27, t. 7. figs. 6, 7.

*P. wosnesenskii*, Mén. l. c. p. 74, t. 1. fig. 3, ♀.

? *P. felderi*, Brem. Lep. Ost-Sibiriens, p. 6, t. 1. fig. 5.

? *P. thor*, H. Edw. Papilio, vol. i. p. 2 (1881).

Whether I am right in uniting the above species time alone will show, but I can see no difference except that of colour between some of the varieties of *P. eversmanni* and *P. felderi*; and though the males appear very different, yet it would be perhaps impossible to say to which species some of the females belong. The examples which I have seen, however, in the collections of Messrs. Dieckmann, Honrath, Staudinger, Fixen, the Hewitson and Godman collections, and that of the St. Petersburg Museum, though somewhat numerous, have never been all compared together, and it is possible that some characters may exist which would serve to separate them.

This species was first made known by a single specimen sent from Kansk, in Siberia, by Dr. Stubbendorf, and figured by Ménétries.

It is a bright yellow male, and resembles those afterwards collected in some parts of the upper Amur region, which are in Hewitson's and Godman's collections, and also the single male from the Yukon river, Alaska, figured by Edwards. The specimen figured as type of *P. felderi* by Bremer, and which appears to be a female, though nothing is said as to sex, was taken by Dr. Radde in the Bureija Mountains north of the Amur river; and the dark and apparently worn female figured by Ménétries as *P. wosnesenskii* was brought from Ochotsk in N.E. Asia. Since then it has remained a rare species, but some examples of *P. felderi* were taken by Christoph at Raddefskaia, on the Amur; and I have seen others in Dr. Fixen's collection, taken at Starikova, on the Amur, and at Raddefskaia, on the 7th and 29th of July. Besides these, a small number of *P. evermanni* have been recently collected near Nikolaievsk, on the lower Amur, by Herr Graesser, and sent to Herr Dieckmann of Hamburg, and others I believe have since been taken in Alaska. It is said by Christoph to be local, and hard to catch, flying over deep bogs. Dr. Staudinger has a male from the Yenesei river, and others from Nikolaievsk at the mouth of the Amur.

In most specimens of *P. felderi* the yellow colour fails almost entirely, and the red ocelli are often absent in the male sex; the yellow hairs of the body and costæ are, however, the same in both forms, though not so abundant in *P. felderi* as in *P. evermanni*. The pouches, which are quite of the same form and size as in *P. mnemosyne*, are alike in both species, and until we know more about them it will be difficult to separate them. The variety named *thor* by Mr. H. Edwards was described from a single male specimen taken in June 1877, 800 miles up the Yukon river, in Alaska, not far from the place where the specimen of *P. evermanni* figured in the 'Butterflies of North America' came. It is described as differing not only in the ground colour, which is sordid white as in *P. clarius*, but in the broader black base of the fore wings, the wider bands, and the much larger proportion of black on both wings. The red spots also are more numerous. The description seems to correspond very fairly with the plate of *P. felderi* given by Bremer. Mr. Edwards hesitated long before describing this as a distinct species, and says that it may ultimately prove to be an extreme variety of *P. evermanni*. In this I quite agree with him, but the propriety of separating any species in so difficult a genus as this on a single specimen of one sex is in my mind most questionable.

Ménétries says that the pouch of *P. wosnesenskii* is very large, nearly like that of *P. mnemosyne*, of a dirty white, with a longitudinal groove below, and another on each side; but on examining his type specimen, which is in very bad order, I noted that the pouch seemed rather like that of *P. clodius* (of which, however, no specimen was available for comparison) than like that of *P. mnemosyne*.

#### P. CLODIUS.

*Parnassius clodius*, Mén. Enum. p. 73 (1855); W. H. Edw. Butt. N. A. i. p. 18, t. 4. figs. 5, 6.

*P. clarius*, Boisd. Ann. Soc. Ent. Fr. 2nd sér. vol. x. p. 283.

*P. baldur*, W. H. Edw. Can. Ent. xi. p. 142 (1879).

*P. clarius*, W. H. Edw. Butt. N. A. i. p. 17, t. 4. figs. 1-4.

*P. menetriesii*, H. Edw. Proc. Cal. Acad. Dec. 18, 1876.

This species, which was described by Ménétries from a specimen brought by Wosnesensky from California, is confined to the Western United States, from California northwards at least to British Columbia, and probably further. For an account of its variations, I cannot do better than quote Mr. H. Edwards's notes on the genus *Parnassius* in Proc. Cal. Acad. July 15, 1878. He says:—"Our most common species is *P. clodius*, Mén., which has a wide range and varies much in different individuals. The typical form of this species, which has the red spots very large and distinct, and the wings nearly opaque, occurs sometimes nearly at sea-level, having been taken by Mr. Behrens at Bodega about 500 feet above the sea, and more recently in large numbers at Tomales in Marin Co. As it approaches the mountains it becomes smaller in size, with the wings more transparent and the spots smaller. It is now known as *baldur*, Edw. = *clarius*, Bdv. nec Eversmann. This form is abundant in some portions of the Sierra Nevada, particularly from about Emigrant Gap to the summit of the Central Pacific Railway, 4500 to 8000 feet. Another form, still more distinct, in which the spots are nearly obliterated, the female closely resembling the male of the *clodius* type, I have ventured to describe as *P. menetriesii*. This is to be taken also at high elevations, my specimens coming from Lake Tahoe and neighbourhood, 4000-5600 feet, and one female from the Wahsatch Mountains, Utah, where it was captured by Mr. J. D. Putnam. Mr. Mead took a grand female recently in the Yosemite Valley, at 4200 feet, and induced her to lay eggs on a plant of *Sedum*, and so we may reasonably hope to know something of the transformations of this exquisite species."

Mr. Edwards says further:—"I have no doubt these are all forms of one species, subject to certain variations from change of food, temperature, and other conditions."

In Mr. Edwards's 'Butterflies of North America,' what he now calls *P. baldur* was described and figured as *clarius*, and he still considers it distinct from *clodius*; but there is little doubt that, as Mr. Henry Edwards says, they are varieties of the same species. The form which I have from Washington Territory is the larger one, and some from Plumas Co., California, are intermediate in size. Mr. Crotch took the larger form in Vancouver's Island; but I do not know how far north it extends, or whether it meets with *P. eversmanni* on the coast of British America, which is not improbable.

The principal character in which it differs from the true Siberian *P. clarius* is the form of the pouch, which in five specimens in my collection is always shorter and broader than in other forms of this group (see Pl. IV. fig. 1); but the yellow hairs of the body and neck and breast will also serve to distinguish it, as these parts are black or grey in *P. clarius*.

Mr. H. Edwards says that *P. clodius* flies with a short jerky

motion, not unlike that of many *Hesperidæ*, taking short flights, settling frequently, and being very easy to capture.

In 'Canadian Entomologist' Mr. Edwards describes the eggs of this species as a little larger than those of *P. smintheus*, of the same shape, covered in the same way with a crust of hexagons; colour pale coffee-brown: laid on species of *Sedum*. The young larva is not distinguishable in shape, markings, or colour from those of *P. smintheus*. Some of the eggs brought by Mr. Mead in September from Nevada hatched in a warm room in February, but the larvæ, though fed on *Sedum*, which some eat pretty well, soon died.

#### P. CLARIUS.

*Parnassius clarius*, Eversm. Bull. Mosc. 1843, iii. p. 539, t. ix. f. a-c; Stgr. Stett. ent. Zeit. 1881, p. 258.

This species was discovered by Schrenck, in the Tarbagatai Mountains, and described by Eversmann, and has since been found by Kindermann between Ustkamenogorsk and Ustbuchtarmnisk in the Altai, and by Haberhauer at moderate elevations near Dschemine near Saisan, in Central Asia. Dr. Staudinger says of the specimens from this place that they are not so strongly marked as those from the Altai, and that the yellow spot on the inner border of the hind wing is wanting, and in one female the yellow ocelli of the hind wing are entirely wanting. The blackish band on the fore wing beyond the cell is also absent, giving the specimen quite the appearance of *P. mnemosyne*, which is found neither in the Tarbagatai, Altai, or Alatau Mountains, but appears again in the mountains of Samarkand. Dr. Staudinger thinks that *P. clarius* is very close to the North-American *P. clodius*, but that the yellowish instead of red ocelli well distinguish it. I would, however, remark that some Altai specimens of *P. clarius*, which I received from Herr Tancré, have the ocelli rather red than yellow, and that the best character by which the two species may be separated is the form of the pouch, which in *P. clarius*, though quite of the same character, is much longer than in any specimens of *P. clodius* I have seen.

Little or nothing is known about the habits of this species, and its range does not seem to extend far to the east or west.

A variety named *dentatus* in some German collections does not appear to have any marked characters, and the name was perhaps given rather for commercial than scientific purposes. Names of this class which have been largely adopted by professional horticulturists, seem likely to become also prevalent among mercantile lepidopterists, and should be treated as they deserve, when discovered. Scientific collectors owe so much to commercial enterprise both in plants and insects, that we must not criticize these practices too severely; but as soon as the love of science becomes obscured by the love of gain, and species-making becomes profitable to the pocket, naturalists must be doubly careful before they accept novelties of this nature.

*P. NORDMANNI.*

*Parnassius nordmanni*, Mén., Nordmann, Bull. Mosc. 1851, p. 423, t. xiii. figs. 1-3.

Var. *minima*, Honrath, Berl. ent. Zeit. 1885, p. 272, t. viii. figs. 2, 2 a.

*P. clarius*, Herr.-Schäff. Pap. Eur. t. liv. figs. 257, 258.

This species appears to have a limited range, being confined to certain districts north and south of the Caucasus, where it seems to represent its near ally, *P. clarius*.

The two species have, in fact, little to distinguish them except colour; but in the type specimens of *P. nordmanni* which I have examined I find the neck is covered with yellow hairs, whilst the palpi and hair of the head, legs, and feet are black, and this is the case in other specimens which I have seen. In one specimen in the St. Petersburg Museum, collected by Haberhauer, and in another which I possess, and which from their small size I believe to be from Daghestan (var. *minima*), the palpi and hair of the head and neck are white. In *P. clarius* the body and legs are greyish; but perhaps the pouch affords the best distinction, as in *P. clarius* it is very long behind, and opens rather upwards; whilst in *P. nordmanni* it is much shorter behind, and cut off in a different way at the opening.

Nordmann says of this species that it flies with *P. delius* in the highest mountains of Adshara in July. He took it in some numbers on the road from Osurgeti in Georgia direct over the Sonlia Mountains to Achalzich, on the slope of the peak called Dshuaruto. Since then no one except Haberhauer seems to have taken it south of the Caucasus, and we have no details of his captures; but Christoph, in his account of his explorations in Daghestan, Hor. Ent. Ross. xii. p. 17, says that it flew on the bare stone-covered slopes of the mountain Bazardjusi, at 13,000 feet elevation. The specimens I have seen from here are all much smaller than those from Georgia, and have been separated by Honrath as "var. *minima*." Ménétries, in his Catalogue, gives Akbasia as a locality, and the Grand Duke Nicholas, in his Catalogue of the Lepidoptera of the Caucasus, says it is found at Kourouch in Daghestan. It remains, however, a rare insect in collections, and its distribution is obscure.

## EXPLANATION OF THE PLATES.

All the objects are magnified 5 times, except the eggs.

## PLATE I

- Fig. 1. Side view of pouch of a female *P. apollo*, from Eperies, Hungary.
2. The same, from behind.
3. Side view of clasping-organs of male *P. apollo*, from Brunnen, Lucerne, taken June 27, 1884. Denuded of hair whilst fresh.
4. End view of same when exposed.
5. Claspers detached from their position.
6. Valves seen from below, when detached.
7. Point of one of the valves, seen from above.
8. Penis.

- Fig. 9. Side view of female *P. delius*, taken in Gantherthal, Valais, July 1, 1884.  
 10. The same, from behind.  
 11. Side view of organs of male *P. delius*, exposed by removal of external covering on one side.  
 12. Egg of *P. delius* from fresh specimen, highly magnified.  
 13 a. Side view of female *P. smintheus*, from Colorado, U.S.A.  
 14 a. End view of same.  
 13 b. Side view of female *P. bremeri*, from Amur.  
 14 b. End view of same.

## PLATE II.

- Fig. 1. Side view of female *P. jacquemonti*, from Ladak.  
 2. End view of the same.  
 3. Side view of female *P. acco*, from Lapsang, Ladak.  
 4. End view of the same.  
 5. Side view of female *P. hardwickei*, from Mandi.  
 6. End view of same.  
 7. Side view of male *P. hardwickii*, the organs exposed by removal of the outer covering.  
 8. The same, as seen from above.  
 9. Side view of female *P. tencidius*, from Albasin, Amur.  
 10. The same, viewed from behind.  
 11. Egg found adhering to the same, highly magnified.  
 12. Side view of pouch of female *P. staudingeri*, from Turkestan.  
 13. End view of the same.  
 14. Male organs of *P. staudingeri* as seen protruded in a specimen lent by Dr. Staudinger, which appears to have been forcibly separated from the female during copulation.

## PLATE III.

- Fig. 1. Side view of female of *P. stoliczkanus*, from Baralacha Pass, Himalaya.  
 2. End view of the same.  
 3. Side view of female *P. imperator*, from Ta-t sien-lo, Tibet.  
 4. End view of the same.  
 5. Side view of female *P. charltonius*, from Lahoul.  
 6. End view of the same.  
 7. Side view of male organs of *P. charltonius*, exposed by removal of side plates.  
 8. Side view of female *P. mnemosyne*, from Berisal, Valais, July 2, 1884.  
 9. End view of the same.  
 10. End view of male organs of *P. mnemosyne* when opened by artificial means, from a specimen in spirit, to show their probable position during copulation.  
 11. The same, as they appear in their natural position.  
 12. Side view of male organs of *P. mnemosyne* when exposed by removal of side plate.  
 12 a. Egg of *P. mnemosyne*, highly magnified.

## PLATE IV.

- Fig. 1. Side view of female *P. clodius*, from Washington Territory.  
 2. End view of same.  
 3. Side view of female *P. eversmanni*, from Amurland, in mus. F. D. Godman.  
 4. End view of the same.  
 5. Side view of *P. clarius*, from Altai Mountains.  
 6. End view of the same.

2. On the Mammals presented by Allan O. Hume, Esq.,  
C.B., to the Natural History Museum. By OLDFIELD  
THOMAS, F.Z.S.

[Received November 16, 1885.]

(Plates V. & VI.)

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Accompanying the magnificent donation of Indian birds recently made to the National Museum by Mr. A. O. Hume, there is a collection of nearly 400 mammals, which, although appearing of small account beside the enormous ornithological series, is yet, viewed on its own merit, one of the finest collections of mammals ever received by the Museum. This is due not only to the large number of the specimens and the excellence of the skins, which are both in preparation and conservation very far above the average, but also to the careful manner in which they have been labelled, nearly all of them having their exact localities and dates recorded. Thus of the 371 specimens retained in the Museum, only 59 are undated, and only some 10 or 12 are without exact localities, while such large series of perfect skins, especially of the Squirrels and other small mammals, have probably never before been brought together.

The collection consists of a few specimens respectively from Simla, Delhi, the Nilghiris, and the Andaman and Nicobar Islands, but the great mass of it came from four separate localities, viz. Sambhar, in Rajpootana, Manipur, Tenasserim, and the Malay peninsula, and I have thought it better not to give one list of the whole, thereby confusing the localities and destroying any use the list might have for faunistic purposes, but to give four separate lists, each of which forms a distinct contribution to the fauna of a well-defined locality.

The total number of species represented in the collection is 106, of which 19 are from Sambhar, 19 from Manipur, 25 from Tenasserim, and 28 from the Malay peninsula, the remainder being from the other localities above mentioned.

Before commencing the detailed lists, I must express my obligations to Mr. W. T. Blanford for the assistance he has given me in working out this collection, an assistance the more valuable as he is himself preparing a work on the mammals of India, and has therefore the whole subject at his fingers' ends. For help also in making out details of localities, dates, &c. I must thank my colleague Mr. R. Bowdler Sharpe, who himself fetched the collection from Simla, and to whose careful packing the excellent condition in which the specimens now are is partly due.



J G Keulemans lith

MUS HUMII

Hanhar. t. imp.





J. G. Keulemans uth.

Hanhart uth

SCIUROPTERUS DAVISONI



## I. THE SAMBHAR COLLECTION.

The collection from Sambhar, Rajpootana, was formed in the winter of 1877-78 by Mr. R. M. Adam, to whom ornithologists are indebted for the "Notes on the Birds of the Sambhar Lake," published in 1873<sup>1</sup>.

The interest possessed by such a series as the present consists in the aid it gives in fixing the north-westerly distribution of the commoner Indian mammals, a point on which we are as yet exceedingly ignorant, and for which authentic lists of the mammals of different localities are much needed. For this purpose Sambhar is an especially useful locality, as it is in this region that the fauna begins to lose its ordinary Indian character and to show signs of the desert influences so marked further west in Sind and the Punjab.

The collection consists of 42 skins referable to 19 species. The skulls have all been cleaned and sent separately, and too much credit cannot be given to Mr. Adam for the care and trouble he has taken in preparing this valuable part of his mammal collection.

## 1. FELIS CHAUS, Güld.

*a.* ♂. Sambhar, 2/2/78. *b.* ♂. Kishungurh, 26/12/77.

## 2. FELIS TORQUATA, F. Cuv.

*a.* ♀. Sambhar, 17/12/77.

## 3. FELIS ORNATA, Gr.

*a-e*, 4 ♂ and 1 ♀. Sambhar, 12/77 and 1/78. *f.* ♀. Kishungurh, 28/12/77.

Mr. Adam obtained no less than six specimens of this rare and beautiful species, which has been hitherto represented in the national collection by only a single half-grown individual collected by Capt. Boys, and by a skull from the Salt Range, obtained by Mr. Theobald. Mr. Adam's series is particularly valuable, as it proves incontestably the validity of the species, which has been confounded by Blyth, Jerdon, and others with *F. torquata*.

## 4. VIVERRICULA MALACCENSIS, F. Cuv.

*a.* ♂. Sambhar, 17/12/77.

This seems to be the most westerly Indian locality from which the Lesser Civet has been recorded, but the species turns up again on the other side of the Indian Ocean in Socotra, the Comoro Islands, and Madagascar, to all of which it has probably been introduced by natives.

## 5. PARADOXURUS NIGER, Desm.

*a-c.* Sambhar, 8 and 9/77.

<sup>1</sup> Stray Feathers, i. p. 361, 1873.

6. *HERPESTES GRISEUS*, Geoffr.<sup>1</sup>  
a-c. Sambhar, 1, 3, and 4/78.
7. *HERPESTES SMITHII*, Gray.  
a. ♂. Sambhar, 13/1/78.
8. *HYÆNA STRIATA*, L.  
a. Sambhar, 17/1/78.
9. *CANIS PALLIPES*, Sykes.  
a. Sambhar, 23/1/78.
10. *CANIS AUREUS*, L.  
a. ♂. Jodhpur, 28/1/78. b. ♂. Nawa, Sambhar Lake, 23/12/77. c. ♀. Goodha, Sambhar, 26/12/77. d. Sambhar.
11. *VULPES BENGALENSIS*, Shaw.  
a. ♂. Sambhar, 17/1/78.
12. *VULPES LEUCOPUS*, Bly.  
a-c. ♂. and 2 ♀. Sambhar, 9 and 12/77. d. ♂. Jodhpur, 26/1/78.
13. *MELLIVORA INDICA*, Bodd.  
a. ♀. Sambhar, 14/1/78.
14. *SCIURUS PALMARUM*, L.  
a. ♂. Sambhar.
15. *NESOKIA BANDICOTA*, Bechst.  
a. ♂. Sambhar, 13/3/78.
16. *NESOKIA HARDWICKEI*, Gr.  
a-e. 3 ♂. and 2 ♀. Sambhar, 6/77 and 1/78.

<sup>1</sup> There has been considerable diversity of opinion as to the name the common Indian Mongoose should bear, some authorities thinking the early name of *Viverra mungo* (Gmelin, Linn. S. N. i. p. 84, 1789) is applicable to it, and others that the *Ichneumon griseus* of Geoffroy (Descr. Egypte, Hist. Nat. ii. p. 133, 1812) includes an African as well as an Indian species, and is therefore not tenable. As to the first point, *V. mungo* was based by Gmelin primarily on the "*Viverra ichneumon* β" of Schreber (Saug. iii. p. 430, pls. cxvi. and cxvii. B). But the latter is made up of a conglomeration of different animals from various localities, the two plates representing, the first *H. griseus* and the second the South-African *Crossarchus fasciatus* (see P. Z. S. 1882, p. 91). In addition *Viverra mungo* includes *Herpestes persicus*, Gay. (= *H. auropunctatus*, Hodg.) as Mr. Blanford has pointed out (Zool. East Persia, p. 42, 1876). In my opinion therefore the only rational method of treating *Viverra mungo* is simply to ignore it altogether.

Passing to the second point, as to the applicability of Geoffroy's *Ichneumon griseus* to this species, I find that although Geoffroy quoted Buffon's "Neins" said to be East African, as identical with his animal, yet his description agrees in every respect with the Indian Mongoose, and he distinctly states that his species came from the "Indes Orientales," so that there is no valid reason why the time-honoured name of *Herpestes griseus* should be superseded.

17. *MUS RATTUS RUFESCENS*, Gr.

a. Sambhar.

Being now quite convinced of the specific identity of *Mus rattus* and *alexandrinus*, I use the Linnean name *rattus* in preference to that of *alexandrinus* provisionally employed in my review of the Indian Rats and Mice<sup>1</sup>.

18. *HYSTRIX LEUCURA*, Sykes.

a. ♂. Sambhar, 27/1/78.

19. *LEPUS RUFICAUDATUS*, Geof.

a-c. Sambhar, 12/77 and 1/78.

## II. THE MANIPUR COLLECTION.

The series from Manipur contains some of the rarest and most interesting of all the mammals presented by Mr. Hume, as was, indeed, to be expected, that country being as yet but little explored, and its mammal fauna being practically unknown. The collection consists of 61 specimens, belonging to 19 species, of which the greater part are decidedly Himalayan in character, the others being either peculiar to Manipur or only otherwise known from Burma. One species and one variety only are new to science, but many are rare and obscure, and all are of the greatest value as filling up an important gap in our knowledge of the fauna of Further India.

With regard to the smaller mammals also, collections from this region are of especial value, owing to the large number of Burmese species described by Blyth that still require proper identification. Notably is this the case among the Rodents, and it is with the greatest satisfaction that I am able to identify several of his species in the present and the Tenasserim collections.

The most important contributions to our knowledge of the mammal fauna of the Manipur region are :—

1. Blyth's posthumous "List of the Mammals of Burma" published as an extra part of J. A. S. B. xliii. 1875, which contains references to all the species then known to inhabit Burma, and in which the greater part of the species represented in Mr. Hume's collection are mentioned; and

2. Dr. Anderson's 'Zoological Results of the two expeditions to Western Yunnan,' 1878, which is less a list of the specimens obtained by the expeditions than a series of monographs of the chief Indian genera of mammals. These monographs, especially those of the *Sciuridæ*, have been of great value to me in working out the Hume collection, and I have made constant references to them throughout.

Mr. Hume has not as yet published his intended account of the Birds of Manipur, but when he does, he will no doubt give full particulars about the localities at which the mammals were obtained.

<sup>1</sup> P. Z. S. 1881, p. 533.

1. *HERPESTES AUROPUNCTATUS BIRMANICUS*<sup>1</sup>, var. nov.<sup>2</sup>

a. Boori bazar, 11/3/81.

This specimen belongs to a race which for some time both Mr. Blanford and I have thought to be new, and of which the Museum possesses two other specimens, one from "Burma" (probably Tonghu) presented by Mr. R. G. Wardlaw-Ramsay and exhibited to this Society as *H. auropunctatus* by Mr. Alston in 1879<sup>3</sup>; and the other from Pegu (10/4/81) presented and collected by Mr. Eugene Oates. Mr. Blanford has also in his own collection a specimen of it from Cachar.

These four specimens are all nearly precisely alike and differ from ordinary Nepalese *H. auropunctatus* by their larger size, heavier build and slightly darker coloration, their superiority in size being especially well marked in their skulls and dentition.

The following are the comparative measurements of Mr. Oates's Pegu specimen, which I will consider as the type of the variety, and of the type of *H. auropunctatus* from Nepal, a fully adult male:—

	Head and body.		Tail.	Hind foot.	
	mm.	mm.	mm.	mm.	mm.
<i>H. auropunctatus</i> , type <sup>4</sup> , ♂..	320		212		48
Var. <i>birmanicus</i> , ♂.....	392		214		55 <sup>5</sup>

Skulls:—			Palate-length.	Palate-breadth.	Incisors to cross-line.	Basi-cranial axis <sup>6</sup> .
	Length.	Breadth.				
<i>H. auropunctatus</i> ,	59·0	30·0	33·0	19·5	23·0	23·0
Var. <i>birmanicus</i> ,	62·7	34·0	34·0	21·8	23·0	25·3

Teeth.—Greatest diameter of	Greatest breadth of pm <sup>4</sup> at right angles to greatest diameter.			
	pm <sup>4</sup>	m <sup>1</sup>	m <sup>2</sup>	
<i>H. auropunctatus</i> , .....	7·0	5·9	3·0	3·2
Var. <i>birmanicus</i> , .....	8·0	6·4	3·1	3·6

It is possible that this variety will hereafter have to be raised to

<sup>1</sup> The question as to whether this should be "*birmanicus*" or "*burmanus*" has given rise to much doubt. Roma makes *romanus* and therefore Burma should make *burmanus*, especially as Burma is undoubtedly the correct, and the French Birmanie an incorrect and corrupt form of the name. Unfortunately, however, not only have the French corrupted the word into Birmanie, but the Italians, to whom we must look as the representatives of the ancient Romans, have also made the same change, calling it "Birmania," whence "*birmanicus*," which I think we must accept as the nearest to the proper Latin for Burmese.

<sup>2</sup> Preliminary diagnosis in Ann. Mag. N. H. (5) xvii. p. 4. Jan. 1886.

<sup>3</sup> P. Z. S. 1879, p. 665.

<sup>4</sup> Measurements taken as explained, P. Z. S. 1882, p. 65, except that in deference to what is now becoming the common practice, I take the "length of skull" from the front of the premaxillæ to the basion, instead of to the back of the condyles.

<sup>5</sup> In the Manipur specimen 58 mm.

<sup>6</sup> Combined lengths of basioccipital and basisphenoid, not including prephenoid as accidentally stated before.

the rank of a species; but until series from intermediate localities are collected it would be unsafe to presume that the differences between the typical *H. auropunctatus* and this variety will not be bridged over.

Some of Dr. Anderson's specimens of *H. auropunctatus*<sup>1</sup> no doubt also belong to this Burmese race.

2. *HELICHTIS PERSONATA*, Geof.

*a. b.* Manipur, 28/2 and 6/3/81.

Dr. Anderson<sup>2</sup> places this species as a synonym of *H. moschata*, Gray; but the most cursory examination either of the original figure or of that given by De Blainville, both referred to by him, would have shown him that it was really different, as the teeth are depicted of a size even larger than is found in either *H. nepalensis* or *orientalis*, the two usually recognized representatives of the large-toothed group, while *H. moschata* is the type of the small-toothed section of the genus.

The very large size of the teeth seems to be a character of the continental lowland race, in contrast to the comparatively small-toothed Nepalese and Javan forms, these having in their turn far larger teeth than the Chinese *H. moschata*. Whether now *H. nepalensis* and *orientalis* are even varietally distinct from each other I am very doubtful, but in any case *H. personata*, although coming from a more or less intermediate locality, is sufficiently distinct from both by its larger teeth and greyer colour, to merit specific separation.

The distribution and relations of these three races, *H. nepalensis*, *orientalis*, and *personata*, form an interesting comment on Mr. Wallace's remarks on the Himalayan, Javanese, and Malay faunas<sup>3</sup>.

3. *TUPAIA BELANGERI*, Wagn.

*a.* Aimole 11/4/81. *b.* Machi 1/5/81.

4. *PTEROPUS MEDIUS*, Temm.

*a.* ♂. Kotschim-kooleh, 7/4/81.

5. *VESPERUGO (VESPERUS) PACHYPUS*, Temm.

*a.* Aimole, 14/4/81.

This somewhat rare species has been found at isolated localities over nearly the whole of the Oriental Region.

6. *VESPERUGO ABRAMUS*, Temm.

*a.* Aimole, 14/4/81.

7. *SCIUROPTERUS ALBONIGER*, Hodgs.

*a.-d.* Machi, 4-10/5/81.

This species differs much more from *S. fimbriatus*, Gray, than is generally recognized. The shape and proportions of its skull and the colour of its incisors are markedly different, and it has no trace of the minute extra hind foot-pad characteristic of *S. fimbriatus*.

<sup>1</sup> *Op. cit.* p. 173.

<sup>3</sup> *Island Life*, p. 353 (1880).

<sup>2</sup> *Op. cit.* p. 193.

I cannot agree with Dr. Anderson as to the identity of the genera *Pteromys* and *Sciuropterus*, which he has united on the plea that the dentition is much the same in both, and that the distichous arrangement is not purely distinctive of the smaller species, but is found partially in some of the larger, while, on the other hand, some of the so-called *Sciuropteri* really have bushy tails. He goes on to say, "The wing-parachute in all the members of the group is the same, although some naturalists have described it in *sagitta* as having an expansion in front of the fore limb which does not exist in the other species; but this is unquestionably an error."

In order to settle the question, I have examined specimens in spirit both of *Pteromys* and *Sciuropterus*, and I find that not only do both have an antebrachial membrane, arising from the back of the cheek and inserted in the front of the carpus, but that there really are important differences in the development and insertion of the parachutes, comparable in some respects to those observable in the wing-membranes of the Chiroptera, differences which, as in the case of the antebrachial membrane, Dr. Anderson must have overlooked through examining dried skins only.

In *Pteromys* there is a broad well-defined interfemoral membrane, inserted externally at the point where the *tendo achillis* is attached to the calcaneum, and internally to the tail from two to three inches from its base, and there is in some of the larger species nearly three inches depth of membrane clear of the hind limb.

On the other hand, in *Sciuropterus* there is either no interfemoral membrane at all, or what there is merely consists of a slight expansion of skin behind the knee, attached externally to the *tendo achillis*, about halfway down, and internally to the hinder side of the hips and never involving any part of the tail.

The lateral membrane also is distinctly narrower, especially below the knee, in *Sciuropterus* than in *Pteromys*, although the longer fringes of hair in the former hide this fact in dried specimens.

Adding to these differences the well-known one in the arrangement of the hairs of the tail, to which I am unable to see the exceptions mentioned by Dr. Anderson, and also those in the dentition described by various authors, I think that it will be admitted that two such natural groups as *Pteromys* and *Sciuropterus* should be allowed to stand as distinct genera.

#### 8. SCIUROPTERUS PEARSONI. Gray.

a. Machi, 7/5/81.

This rare species would be naturally expected to occur in Manipur. It has previously been recorded from Sikkim, Assam, and Yunnan.

#### 9. SCIURUS INDICUS, Erxl.

a. ♂. Gurung R. 8/2/81.

The present is by far the most easterly locality as yet recorded for this species, and extends its known range very considerably, the Terai region of Nepal (*Hodgson*) and Cuttack (*Anderson*) having

been hitherto its most easterly localities recorded. I am altogether unable to perceive on what grounds Dr. Anderson keeps *S. maximus*, Gm., separate from this, as although he gives detailed descriptions of both, he omits any comparison between the two. In my opinion the two are certainly specifically identical, and Dr. Jentink is also of the same opinion<sup>1</sup>.

10. *SCIURUS ERYTHRÆUS*, Pall.

*a-c.* Noong-zai-bau, 2/2/81. *d.* Koomberong, 6/2/81.

*e-i.* Aimole, 13 to 19/4/81. *j, k.* Machi, 30/4 and 1/5/81.

Of these specimens all those from Noong-zai-bau and Koomberong are comparatively darker, both above and below, and more finely punctulated than any of those from Aimole and Machi, and more nearly approach the "*S. punctatissimus*" of Gray.

As all the first set were taken in February, and all the second in March, the difference, judging from Mr. Hume's series only, might have been suspected to depend on date and not on locality; but this idea is dispelled both by the absence of any patchiness or other sign of change in the skins, and by the fact that a specimen of *S. punctatissimus* in the Museum, from Cachar, is dated June, whereas, were the change seasonal only, this form should, on the evidence of the Manipur specimens, represent the winter and not the summer dress of *S. erythræus*.

The species seems, in fact, to be peculiarly susceptible to local influences, as every locality represented in the combined Museum and Hume collections has a more or less different race. Thus Bhotan and Western-Assam specimens are dark with a rufous tinging, an Eastern-Assam one pale with a yellowish wash, this leading naturally into the pale Aimole and Machi Manipur specimens. After these, again, comes the darker Noong-zai-bau and Koomberong race, which finally grades into the extremely dark, finely punctulated *S. punctatissimus* from Dilkoosha, Cachar.

11. *SCIURUS LOKRIOIDES*, Hodgs.

*a-d.* Machi, Aimole, and Phalel, 4/81. *e.* Jherighat, 1/2/81.

12. *SCIURUS LOKRIAH*, Hodgs.

*a, b.* Aimole, 4/81.

13. *SCIURUS MACCLELLANDI*, Horsf.

*a-g.* Aimole, 13-25/4/81. *h.* Machi, 7/5/81. *i.* Loanglol, 13/2/81.

These specimens are interesting as being almost precisely intermediate between the *S. macclellandi typicus* of Nepal and Assam, and the Tenasserim *S. macclellandi barbei*, Bly. *S. macclellandi swinhoei*, M.-Edw., of Moupin, Thibet<sup>2</sup>, seems also to be a recognizable race of the present species.

*S. macclellandi* possesses six mammæ, one lateral and two inguinal pairs.

<sup>1</sup> Notes Leyd. Mus. 1883, p. 106.

<sup>2</sup> Rech. Mamm. i. p. 308 (1868-1874).

14. *MUS BOWERSI*, Anders.<sup>1</sup>

a. ♀. Machi, 8/5/81.

There is nothing in Dr. Anderson's description of his *Mus bowersi* absolutely to prevent the present specimen belonging to it; but the differential characters of these *Muridae*, obvious enough on actual comparison, are often so difficult of description that I should not be surprised if the present were to turn out to be distinct from *M. bowersi*, especially as the figure of that animal is by no means identical with Mr. Hume's specimen, but is more similar to the species of the group to which *M. germaini*, M.-Edw., belongs. However, there can be no question that for the present the Manipur Rat should rather be referred to *M. bowersi* than be described as new. Dr. Anderson's type was obtained at Hotha, Yunnan, at an elevation of 4500 feet.

15. *MUS BERDMOREI*, Bly.

a, b. Kopum Thall, 11/2/81.

These two specimens agree so closely with Blyth's short description<sup>2</sup> that I have no hesitation in referring them to his species, even though Blyth himself afterwards placed *M. berdmorei* as a synonym of *M. robustulus*, Bly. (= *M. rattus rufescens*, Gr.), and though the locality of Blyth's specimen, Mergui, Tenasserim, is so distant and has so different a fauna from Manipur.

The following description, based on Mr. Hume's two skins, will serve to supplement the short and unsatisfactory one given by Blyth:—

General colour clear slaty grey, the tips of some of the hairs brown and of others white, the mixture giving a very finely grizzled appearance to the back, in which no trace of yellow or fawn is present; chin, chest, and belly pure white. Ears outside brown, inside silvery; feet white; tail bicolor, black above and white beneath for half its length, the terminal half white all round; the tip not pencilled.

Fur of only one sort, stiff and hispid, but with no trace of spines. Tail about the length of the head and body combined, or a little shorter. Ears large and evenly rounded; fifth hind toe reaching to the middle of the first phalanx of the fourth. Foot-pads large and prominent.

Skull with its facial portion unusually long, nasals long and narrow, surpassing in length the ascending premaxillary processes; supraorbital ridges well defined; anterior plate of zygoma well developed, very convex forward. Palate very long, the interval between the back of the incisors and the molars very much longer than usual; palatine foramina rather short, terminating about 1mm. in front of m<sup>1</sup>; posterior nares opening at the level of the hinder edge of m<sup>3</sup>.

Incisors pale yellow, lightening to white at their tips, directed

<sup>1</sup> Zool. Yunn. Exp. p. 304, pl. xvii. (1878).

<sup>2</sup> J. A. S. B. xx. p. 173 (1852).

much more forward than usual. Molars very small in proportion to the size of the animal, their pattern as usual.

*Measurements.* Head and body 174 mm.; tail 172; hind foot 36; fore arm and hand 44; ear (above crown) 16; heel to front of last foot-pad 17.4.

*Skull.* Bregma to tip of nasals 35.0; greatest breadth 21.5; nasals, length 16.0; interorbital breadth 7.0; length of face 21.8; palate, length 22.4; incisors to m<sup>1</sup> 14.1; palatine foramina 7.8; molar series 6.1; anterior zygoma-root 4.7; lower jaw, bone only, 25.1; to incisor tips 30.6.

This species is allied to *Mus blanfordi*, Thos., and *Mus con- fucianus*, M.-Edw., but differs from both by its clear grey colour, without any trace of yellow in it, by its shorter tail, forwardly directed and paler-coloured incisors, longer palate, and smaller molars.

16. *MUS HUMEI*, sp. n.<sup>1</sup> (Plate V.)

*a-f.* 2 ♂ and 4 ♀. Moirang, 23/3/81.

The collection contains six specimens of this striking new species, which I have much pleasure in dedicating to the donor of the present magnificent addition to the National Collection of mammals.

General colour above exceedingly like that of *Golunda ellioti*, Gr., viz. coarsely grizzled grey, lightest on the head and gradually turning to deep rufous on the rump, the tips of the great majority of the hairs being white or yellowish white on the head and fore quarters, and gradually becoming rich rufous on the hind quarters, their bases in all cases deep slaty-blue. The other hairs are black throughout, and form the black element in the general grizzling. Sides like the fore quarters. Belly yellow or orange, mixed with the slate of the hair-bases; no black-tipped hairs below. The inner sides of the thighs and all round the base of the tail rich rufous.

The fur throughout is soft, and unmixed with flattened or spinous bristles.

Feet grizzled yellowish white. Ears thinly covered outside with black hairs, and inside with black and yellow or red ones; an indistinct tuft of orange-tipped hairs in front of the basal notch. Tail well haired, but not pencilled, markedly bicolor, the hairs black above and white below, but the scales, even of the lower side, are uniformly brown.

Ears large and evenly rounded, with a small projection in the middle of their inner margins; laid forward they reach to the posterior corner of the eye. Tail about as long as the body without the head. Fifth front toe unusually short, its claw barely reaching to the bottom of the division between the 2nd and 3rd toes, giving the foot, at first sight, the appearance of being only provided with three toes. Fifth hind toe reaching just to the base of the fourth. Foot-pads 5-6. Mammæ 8, 2 pectoral and 2 inguinal pairs.

Skull, both in size and shape, almost identical with that of *Golunda ellioti*<sup>2</sup>, Gr., with the two following exceptions:—(1) The front

<sup>1</sup> Preliminary diagnosis published *Ann. Mag. N. H.* (5) xvii. p. 84, Jan. 1886.

<sup>2</sup> Figured by Blandford, *J. A. S. B.* xlv. pl. x. (1876).

edge of the anterior zygoma-root is concave, with an overhanging point<sup>1</sup> instead of being convex, (2) the palate is produced to behind the edge of the last molar, instead of ending opposite its centre. The first of these characters, although fairly common among the Australian Muridæ, is, to the best of my knowledge, not found in any of the other Muridæ either of Asia or Africa. In all other characters, in the development and direction of the supraorbital ridges, the length and shape of the nasals, the angles formed by the sutures on the brain-case, the length of the palatine foramina, &c., the two skulls are absolutely identical.

Teeth large and powerful; incisors short and stout, the lower ones projecting only about 3 mm. beyond the bone, smooth, rounded, and ungrooved in front, dark orange-yellow above, rather lighter below; molars broad and heavy, their structure as in *Mus*, and with no resemblance to those of *Golunda*; last molar nearly as large as the second, consisting both above and below of two well-defined equal-sized laminae.

*Measurements* of the largest skin, a female. Head and body 125 mm.; tail 106; hind foot 25.0. Of a specimen softened and placed in spirit, head and body 118.0; hind-foot 26.5; heel to front of last foot-pad 12.0; forearm and hand 31.5; ear, above crown, 12.0.

*Skull.* Length, bregma to nasal-tip 26.0; greatest breadth 15.0; length of face 14.5; nasals, length 10.0; interorbital breadth 4.5; palate, length 16.0; incisors to m<sup>1</sup> 8.3; palatine foramina 5.1; molar series 5.8; length of anterior zygoma-root 4.0; lower jaw, length (bone only) 18.3; to incisor-tips 19.2; projection of incisors (behind) 4.5.

The general appearance of this species is infinitely more like that of the Gulandi (*Golunda ellioti*) than that of any of the other Indian members of the genus *Mus*. So like *Golunda* is it, indeed, in colour, proportions, and even in the general shape of its skull, that it might easily be mistaken for this animal, were it not for its slightly longer tail, less spiny fur, ungrooved incisors, and a few other little prominent characters which might easily be overlooked by a superficial observer. It thus seems to bear the same interesting relationship to the Gulandi that *Sigmodon hispidus*, S. and O., does to *Rheithrodon alstoni*, Thos.<sup>2</sup>

The only species to be referred to in describing *M. humei* as new is *Mus erythrotis*, Blyth<sup>3</sup>, from the Khasia hills, the colours of which agree very closely with those of this species, but which is stated to be only 57 mm. in length, with a tail 60 mm. long, and a hind foot, including the claws, only 17.4 mm. long, a difference in size far too great to admit of any question as to the specific distinction of the two animals.

<sup>1</sup> This type of zygoma-root is figured Ann. Mag. N. H. (5) ix. p. 414, fig. 3 (1882).

<sup>2</sup> See P. Z. S. 1880, p. 693.

<sup>3</sup> J. A. S. B. xxiv. p. 721 (1855).

17. *MUS CERVICOLOR*, Hodgs.

*a.* Boori-bazar, 11/3/81.

This is evidently Blyth's *M. cunicularis*<sup>1</sup> described from the Khasia hills, and bears out my suspicion that that is merely a synonym of *M. cervicolor*<sup>2</sup>.

18. *VANDELEURIA OLERACEA*, Benn.

*a, b.* Boori-bazar, 11/3/81.

Dr. Anderson (Zool. Yunn. Exp. p. 313, 1878) has already noted the presence of this interesting little species in Burma and the neighbouring countries. It seems probable that *Mus badius*, Blyth (J. A. S. B. xxviii. p. 295), described from the valley of the Sitang, should be added to the synonyms of *V. oleracea*.

19. *RHIZOMYS BADIUS*, Hodgs.

*a-f.* 4 adult and 2 young. Boori-bazar, 11 and 12/3/81. *g, h.*  
2 young, Moirang, 22/3/81.

The young specimens are interesting as showing that this species only assumes its rich chestnut-colour in adult age, as they are all of a hue more resembling that of *Rh. pruinusos*, Bly., than that of the adult animals along with which they were caught, and of which they are presumably the young.

## III. THE TENASSERIM COLLECTION.

Next in interest to the Manipur mammals come those from Tenasserim, collected nearly entirely by Mr. Davison in 1877 and 1878, at the time when Mr. Hume was bringing together materials for the valuable paper on the Birds of Tenasserim published in 1878<sup>3</sup>. In this paper may be found a description (p. 522) of all the localities at which Mr. Davison worked, and at which therefore these mammals were obtained. It was on this collection that Mr. Blanford's paper "On some Mammals from Tenasserim"<sup>4</sup> was based, and in the present account there are therefore no novelties to be described, that author having then named, described, and figured the two remarkable species *Prionodon maculosus* and *Sciurus rufigenis*, the typical specimens of which are in Mr. Hume's collection. As Mr. Blanford's paper is not, however, a full account of the collection, but merely consists of notes on the rarer and more interesting species, I have considered it advisable, notwithstanding his paper, to write a list of the Tenasserim as well as of the other mammals of the Hume collection.

Tenasserim mammals are of interest chiefly on account of the passage that takes place in that country from the Burmese to the Malay fauna, as we find that the South Tenasserim species, those from Bankasun, are more or less Malay in character, and add several species to the list of the mammals of British India, while on the

<sup>1</sup> J. A. S. B. xxiv. p. 721 (1855).

<sup>2</sup> P. Z. S. 1881, p. 548.

<sup>3</sup> 'Stray Feathers,' vol. vi. 1878.

<sup>4</sup> J. A. S. B. xvii. p. 150 (1878).

other hand those of North Tenasserim are nearly entirely Burmese, although but few of them, again, are the same as the species found still further north in Manipur.

The careful and conscientious manner in which Mr. Davison's collecting and labelling is done is nowhere more conspicuous than in the beautiful series obtained by him in Tenasserim, so that the number and excellence of the skins, and above all, the careful preservation of the dates of capture, have been to me, and I hope will be to others, of the greatest possible service in making out the problems of distribution, and of local, sexual, and seasonal variation.

The collection contains 86 specimens, referable to 25 species.

1. *HYLOBATES LAR*, L.

*a, b.* Myawadi<sup>1</sup>. *c.* Kankaryit, 13/1/77. *d-g.* Bankasun, 4-6/77.

2. *SEMNOPITHECUS FEMORALIS*, Horsf.

*a.* Bankasun, 15/4/77.

This rare species forms an addition to the fauna of Tenasserim, the few localities as yet recorded for it being all either in the south of the Malay peninsula or in Sumatra. Mr. Davison's specimens precisely agree with Horsfield's type preserved in the Natural History Museum.

3. *SEMNOPITHECUS OBSCURUS*, Reid.

*a, b.* 5000', Mt. Mooleyit, 30/1/77. *c.* Foot of Mt. Nwa-laboo, Tavoy, 10/4/78. *d.* Bankasun, 25/5/77.

Specimen *d* is a very remarkably coloured individual differing from all others that I have seen in having its crest, nape, arms and legs, and tail yellow, contrasting markedly with the dark hues of the face, body, and feet. It is, however, led up to by a specimen in the Museum from Malacca, collected by Dr. Cantor<sup>2</sup>, which has its crest yellow and its limbs and tail lighter than usual. I am therefore indisposed at present to look upon the Bankasun specimen as more than an individual variety. It must, however, be mentioned that its auditory bullæ are larger and more projecting, and its teeth smaller than is usually the case; but with only a single specimen, these characters are not sufficiently tangible to found a new species upon.

4. *MACACUS CYNOMOLGUS*, L.

*a.* Wimpong, Thatone.

5. *PRIONODON MACULOSUS*, Blanf.

*a.* Bankasun (co-type of species. Figured J. A. S. B. xlvii. pl. vi. 1878).

This is the original skin described and figured by Mr. Blanford,

<sup>1</sup> Specimens to which no collector's name is attached were obtained by Mr. Davison.

<sup>2</sup> No. 79. 11. 21. 596.

while the spirit specimen from Moulmein, mentioned at the same time, has already been generously presented to the National Collection by him.

6. *PARADOXURUS HERMAPHRODITUS*, Pall.

*a.* Wimpong, Thatone.

As Mr. Blanford has shown (*P. Z. S.* 1885, p. 794), Pallas's *P. hermaphroditus* should be referred to the common Malay Palm-civet, which has hitherto been known either as *P. musanga*, Raff., or *P. fasciatus*, Gr.

7. *MUSTELA FLAVIGULA*, Bodd.

*a.* Mt. Nwa-la-boo, Tavoy, 7/4/78. *b.* Bankasun, 20/6/77.

8. *GYMNURA RAFFLESI*, Vig. and Horsf.

*a.* Bankasun (Blanford, *tom. cit.* p. 150).

Its only known occurrence within British India.

9. *TUPAIA BELANGERI*, Wagn.

*a-h.* various localities, Tenasserim.

This is the *T. peguana*, of Mr. Blanford's list. It may generally be distinguished from the next species by the presence of a well-developed internal cusp on its second upper premolar.

10. *TUPAIA FERRUGINEA*, Raff.

*a.* Bankasun, 27/4/77. *b, c.* Tenasserim.

11. *PTEROPUS MEDIUS*, Temm.

*a.* Amherst, near Moulmein.

This appears to be about as far south-eastwards as this species has been recorded, its place further south being taken by *Pt. edulis*, Geoffr.

12. *RHINOLOPHUS TRIFOLIATUS*, Temm.

*a, b.* Mergui (Hume).

It is important to have additional localities for this rare species, of which the exact range is by no means satisfactorily settled.

13. *PTEROMYS CINERACEUS*, Bly.

*a.* Wimpong, Thatone, 21/12/76. *b.* Kankaryit.

This species seems to be hardly more than a geographical race of the well-known Indian Flying-squirrel (*P. petaurista*, L.). The measurements of *a* were published by Mr. Blanford (*l. c.* p. 165).

14. *SCIURUS BICOLOR*, Sparrm.

*a, b.* Thoungyah, 26 and 30/9/78 (Darling). *c.* Mergui, 10/1/79. *d, e.* Bankasun, 18/3/77 and 3/6/77.

No seasonal change is appreciable among the large series of this species in the Tenasserim and Malayan collections.

15. *SCIURUS CANICEPS*, Gray.

*a, b.* Moulmein. *c.* Kankaryit, 13/1/77. *d, e.* Thoungveen River, 9 and 10/77 (Bingham). *f, g.* Thoungyah, 16/1/77 (Davison), 10/10/78 (Darling). *h.* Myawadi, 2/10/77 (Bingham). *i.* Tavoy, 16/3/78. *j-l.* Bankasun, 6/77 (*S. phayrei*, Bly.). *m, n.* Pahpooon, W. Tenasserim. *o.* Thatone, 23/11/77.

This fine series, with the seven Malayan specimens from Kussoom, (27/5/79), Taroar (12/2/79), Poongah (8/79), and Salanga (2 and 3/79), collected by Darling, form an invaluable addition to the material for making out the relations, variation, and distribution of this troublesome species and its allies.

Dr. Anderson, although he gives separate headings in his monograph to *S. pygerythrus*, *caniceps*, *phayrei*, *blanfordi*, and *griseimanus*, states that he believes that they are all closely related to one another and should not perhaps be specifically separated.

On laying out, arranged as it were on an imaginary map, the whole available series of skins, 70 in number<sup>1</sup>, belonging to the above species, one is able to make out five recognizable forms grading into each other in various degrees, of which two occur in North Tenasserim, one in Pegu and Upper Burma, another in Cambodja and Cochin China, and the fifth in S. Tenasserim and N. Malaysia; but anything more complicated than their inter-relations it is hard to conceive, and they seem to be only definable by a free use of trinomial nomenclature.

As the easiest method of explaining their relationships I will attempt to trace out the history of *S. caniceps*, which appears to have been something as follows:—

The original of the species, occurring about the centre of the present range, would be such an animal as summer non-breeding specimens of the true *S. caniceps* of N. Tenasserim now are, viz. grizzled yellowish grey above and grey below, the sides of the neck and the sides of the belly being more or less tinged with yellow (85. 8. 1. 177<sup>2</sup>). The struggle for existence then necessitated a richer ornamentation, at least in the breeding-season, and this was accomplished in various ways in different parts of the animals' range. North-western specimens, those of Burma and Pegu, became rich yellow underneath (*S. pygerythrus*, 81. 12. 2. 7), and eastern ones, in Cambodja &c., a duller yellow below, with whitish feet (*S. griseimanus*, 78. 6. 17, 29), both forms having occasionally, presumably by atavism, ordinary grey-bellied specimens, *e. g.* 81. 12. 2. 9 from Pegu and 62. 8. 16. 4 from Laos. Southwards, beginning about at Tavoy, and reaching down to Malacca, the yellow tinge of the sides of the neck and belly were replaced by rich orange-red,

<sup>1</sup> Of these, 22 belong to the Hume, 25 to the old Museum collection, and 23 have been kindly lent to me by Mr. Blanford out of his own collection.

<sup>2</sup> These numbers are those of the registers in the Natural History Museum, and will always identify the particular phase of fur referred to.

forming a very handsome ornamentation (82. 3. 9. 5, Junkceylon). This race represents *S. concolor*, Bly.<sup>1</sup>

These three forms are all without any marked seasonal change of colour; but in the next race, which is the original stock living in N. Tenasserim, an entirely different sort of ornamentation has been set up in the form of the assumption, during the rutting-season only, of a brilliant orange-yellow back, the sides and belly still remaining dull grey (*S. caniceps typicus*, 85. 8. 1. 178).

Further to complicate matters, the north-western yellow-bellied race (*S. caniceps pygerythrus*) has again spread southwards and overlapped the range of *S. caniceps typicus*, which, being now provided with a highly specialized seasonal change of colour, has driven it to adopt a still further development of its own form of ornamentation, namely, the production of a dark brown stripe between the upper grey and the lower yellow, which shows up the latter in the most brilliant manner possible (*S. phayrei*, 85. 8. 1. 175, Thatone).

The original grey *S. caniceps* has thus, except in the unornamented summer race of var. *typicus*, become entirely extinct, and has been replaced by its variously decorated offshoots.

With regard to nomenclature I think it is impossible to express the present state of things in a binomial manner, but by using the following trinomials we may perhaps approach more closely to the truth:—

*S. CANICEPS PYGERYTHRUS*<sup>2</sup>, Geof.

(*S. blanfordi*<sup>1</sup>, Bly.)

No seasonal change; belly yellow.

Burma and Pegu.

*S. CANICEPS PHAYRII*, Bly.

No seasonal change; belly rich orange, with brown lateral stripes.

Pegu and N. Tenasserim.

*S. CANICEPS GRISEIMANUS*, M.-Edw.

(*S. inornatus*, Gr., *S. leucopus*, Gr.)

No seasonal change. Belly pale yellow. Feet white. Black tail-tip nearly obsolete.

Cambodja &c.

<sup>1</sup> J. A. S. B. (xxiv. p. 474, 1855), apud Blandford (J. A. S. B. xlvii. p. 161, 1878), who in describing the present series of Bankasum specimens belonging to this form says, "These dark olivaceous forms may perhaps be sufficiently distinct to constitute a local race for which Blyth's name *S. concolor* may be retained, but they are not, I think, really separable from *S. caniceps*." Anderson, on the other hand, places *S. concolor* as a synonym of *S. modestus*, without any remark; but pending a renewed examination of the type, I prefer to take Mr. Blandford's authority, as this course enables me to avoid giving the southern race a new name.

<sup>2</sup> The full references to all these names will be found in Dr. Anderson's 'Monograph,' pp. 227-253.